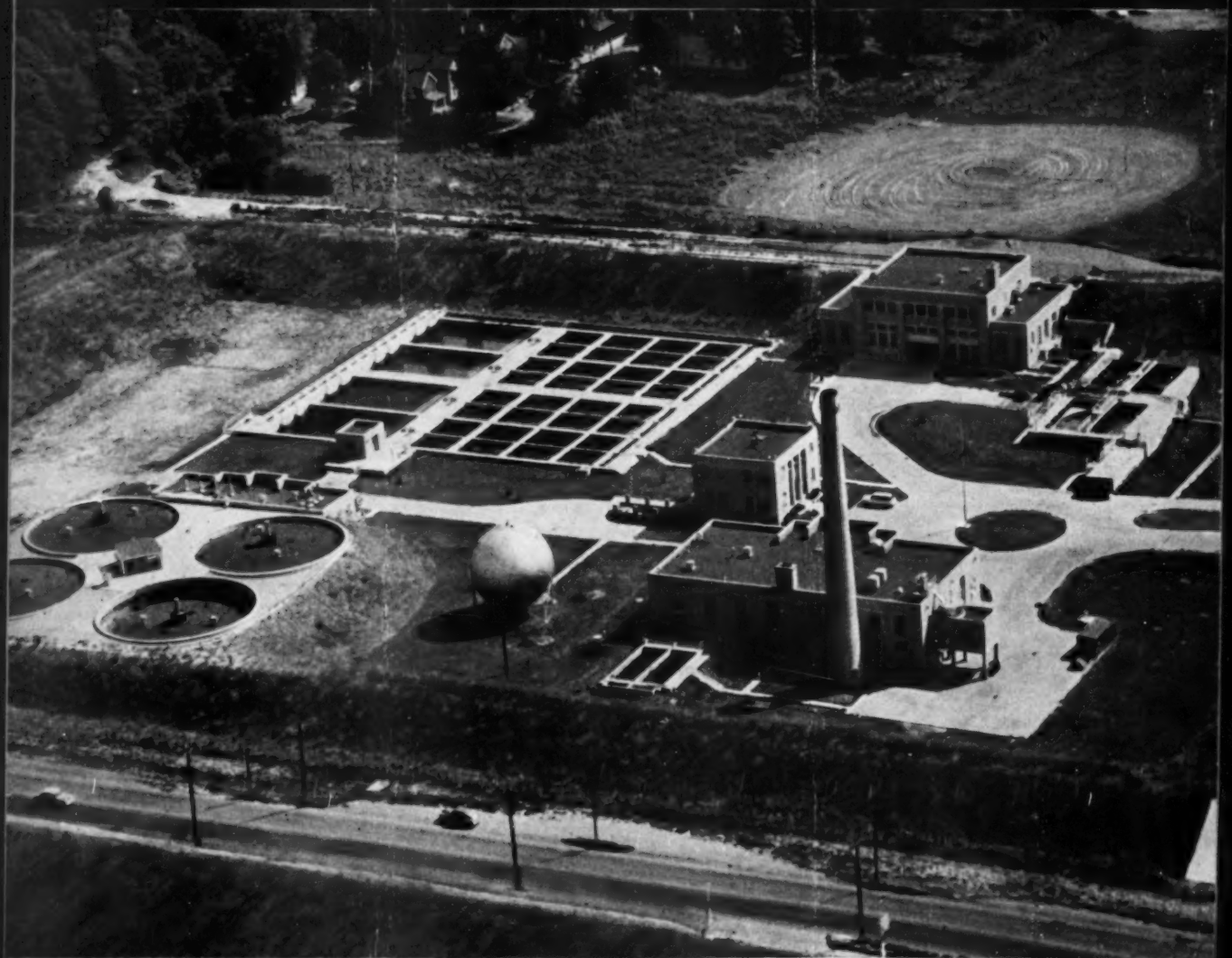
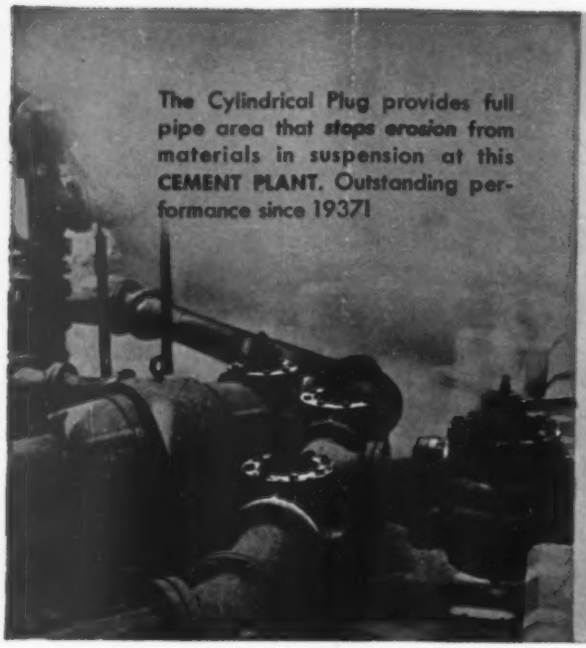
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

OCTOBER 1954



Cincinnati's New Eight Mgpd Sewage Treatment Plant—See Page 423



The Cylindrical Plug provides full pipe area that *stops erosion* from materials in suspension at this **CEMENT PLANT.** Outstanding performance since 1937!

In **SEWAGE PLANTS,** acf Cylindrical Plug shears obstructions on raw sewage and sludge lines or, as here, controls gas for heat booster on digestor circulating water.

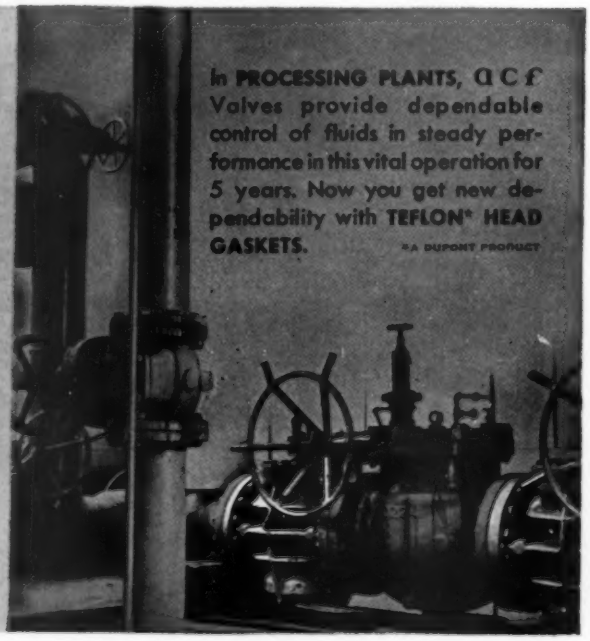
PROOF OF SUPERIORITY

acf CYLINDRICAL FULL PIPE AREA **PLUG VALVES**

Representatives in 50 Principal Cities

Write for descriptive Catalog 4-WS to ACF Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Michigan.

Quick, quarter-turn shut-off provides positive, immediate control vital to this **NATURAL GAS OPERATION.** Straight-through streamline flow in acf Valves assures least turbulence and pressure drop at all times.



In **PROCESSING PLANTS,** acf Valves provide dependable control of fluids in steady performance in this vital operation for 5 years. Now you get new dependability with **TEFLON* HEAD GASKETS.**

*A DUPONT PRODUCT

When ground water infiltration is a problem...

Always specify vitrified CLAY PIPE

MURRAY CITY, UTAH, adds another 22,975 ft. of Vitrified Clay Pipe to its sewerage system to serve a new housing area. Because of the high water table in some sections of the project, the trench bottom had to be boxed in and pumped dry while the pipe was laid three sections at a time. Officials directing various phases of the project include City Engineer D. H. Wood, Assistant City Engineer John N. Neff, Installation Foreman John Carolo, and Pipe Foreman Ken Farrell. General Contractor is The Statewide Plumbing and Heating Co.

Wherever the water table is high, sanitary engineers experienced in handling infiltration problems choose Vitrified Clay Pipe. The wide selection of factory-made joints or in-the-trench jointing techniques permit the kind of installation that suits each project . . . each trenching problem . . . each locale.

And once in the ground, Vitrified Clay Pipe is *down to stay.* It is confidently guaranteed for 50 years.

Officials at Murray City specified Clay Pipe even before they submitted the bond issue to the voters—smart planning that assures the community of trouble-free service long after the bonds mature. For sewers that *must* be permanent, always specify, buy, and install Vitrified Clay Pipe. There's no safe substitute for the *one* pipe that never wears out.

Vitrified
CLAY
CLAY PIPE NEVER WEARS OUT!
PIPE

C-454-2

NATIONAL CLAY PIPE MANUFACTURERS, INC.
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IS PURE • TASTELESS • ODORLESS

Your community is interested in *more* than just pure water. Local sanitation engineers are often faced with problems of disagreeable tastes and odors which cannot be controlled by regular water treatment methods.

Today, over 150 communities are using the Mathieson Chlorine Dioxide process to eliminate unpleasant tastes and odors. Chlorine dioxide is not only a dependable disinfectant, but its powerful oxidizing action...

- destroys tastes and odors from algae and other organic matter
- changes manganous salts to insoluble manganic compounds
- oxidizes objectionable compounds formed during regular chlorination
- helps maintain an active chlorine residual throughout distribution system
- is effective in even highly alkaline and softened water

Treatment of potable water with Mathieson Chlorine Dioxide is neither complicated nor expensive and it requires only the simplest of equipment. And Mathieson's comprehensive technical service is a PRODUCT-PLUS that assures you of a system best suited to your needs. Get complete information from your Mathieson representative or write today.

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OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION
Baltimore 3, Maryland

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caustic soda • soda ash • chlorine • sulphur • sulphuric acid • bicarbonate of soda • ammonia • sodium nitrate • nitric acid • hydrazine products
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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

Guide to Legal Problems in Water Works Operation ..... *Murdoch*
Fluoridation by Automatic Control ..... *Knowlton*
Our Dwindling Clean Water Supply ..... *Furhman*
Remodeling a Water Filtration Plant ..... *Martin*
Water Filtrability Can be Measured ..... *Matheson*
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In two continuing series of articles
"WATER WORKS PRACTICES" are discussed by *Dr. George Symons*
"SEWAGE WORKS PRACTICES" are discussed by *Prof. Don Bloodgood*

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STEEL PIPE solves headroom problem as Newark modernizes vital water control station

Back in 1800, the community of Newark, New Jersey, used a water supply system of hollow logs. Today, over 50 miles of huge steel primary feed lines rush upstate water to more than half a million people.

Focal point of this system, which includes nine major reservoirs and over 150 square miles of watershed, is the Bloomfield Avenue Tower, terminal for five of the six main feeder lines. Modernization recently called for replacement at the tower of 35 small double-gated valves with 8 new cone-type valves and requisite piping to handle the system's high pressure flow.

Low headroom and critical location made pipe selection particularly vital. The problem was solved with Alco Electric Welded Steel Pipe—1650 ft of 48-in., 450 ft of 36-in. and 30 ft of 60-in. pipe. Through it will surge over 85 million gallons of water per day.

Furnished in diameters from 20 to 120 in. and lengths to 40 ft, Alco Electric Welded Steel Pipe is specified the country over for its engineered strength, efficiency, economy and long life.

So whether your installation is large or small, special or standard, have a talk with your Alco Products sales representative. He will give you complete technical data—plus expert help with your own special problems.

CITY OF NEWARK uses strong, efficient Alco Electric Welded Steel Pipe in 36, 48 and 60-in. diameters and special sections (shown above) at vital Bloomfield Tower control station.

COMPLETE, modern facilities and many years of experience enable Alco to fabricate top quality low cost pipe for almost any installation, standard or special.

Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading due to earth movement and washouts.

EFFICIENT: Positively watertight. Minimum number of field joints. Smooth surfaces for highest rate of flow.

ECONOMICAL: Low first cost. Long lengths, light weight for easy installation.

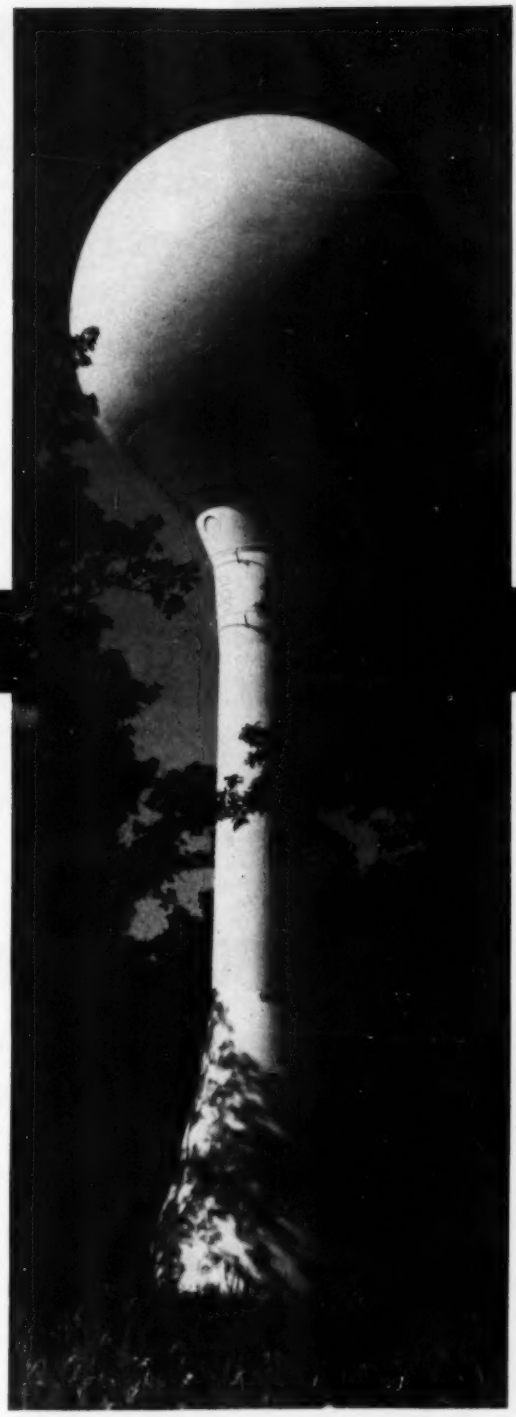
DURABLE: Life in water supply installations estimated conservatively at 75 to 100 years.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
DUNKIRK, N. Y.

Sales Offices: New York, Chicago, Dunkirk, Los Angeles Kansas City, Houston, Tulsa and Beaumont.

new water system built around a WATERSPHERE



The town of Blooming Grove, Wisconsin, population 4,000, recently installed this 100,000-gallon Horton Watersphere® to provide storage for their municipal water distribution system.

Water for the system is pumped directly from a well to the Watersphere, where it is stored until needed for general service or fire protection. Although the system is new, and has only been in service for a short while, it has been firmly established that distribution pressures remain high and uniform, even during peak load periods. General Engineering Company, Portage, Wisconsin, were consulting engineers on the job.

Modern, streamlined Waterspheres for municipal or private water service are built in standard capacities from 25,000 to 250,000 gallons. Write our nearest office for estimates or quotations on a Watersphere or Horton elevated tank to put new life into your water system.

HORTON

WELDED STEEL STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Bldg.	Los Angeles 17	1555 General Petroleum Bldg.
Birmingham 1	1586 North Fiftieth St.	New York 6	3390—165 Broadway Bldg.
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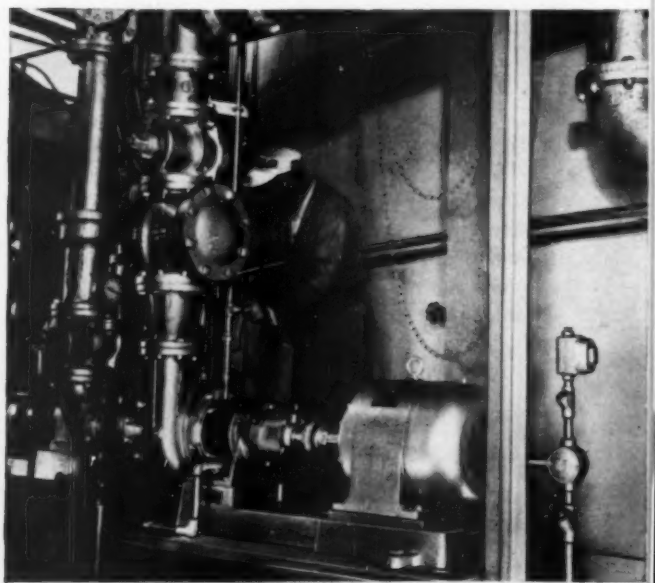
Havana	402 Abreu Bldg.	Seattle 1	1350 Henry Bldg.
Houston 2	2115 C & I Life Bldg.	Tulsa 3	1646 Hunt Bldg.

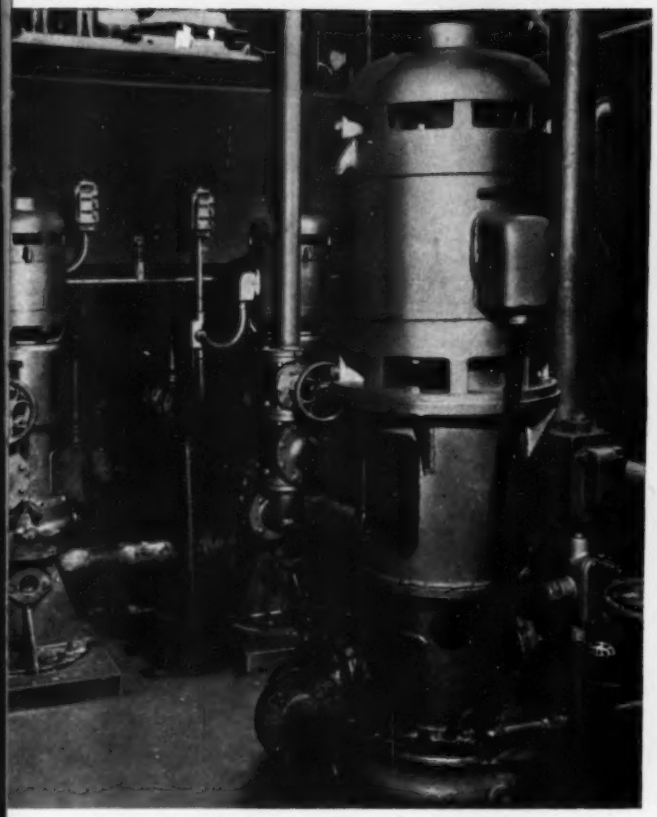
REMODELED AND EXPANDED FACILITIES at the City of Norwalk Sewage Treatment Plant showing (foreground to background) digester, sludge pumping station, sedimentation tanks, and screening and main pumping building. The plant now has a capacity of 22.5 mgd after having been rebuilt to meet the demands of a substantial population increase.

Norwalk remodels sewage plant to bring

IN THE MAIN PUMP ROOM of the remodeled City of Norwalk Sewage Treatment Plant, four G-E 75-hp motors provide rugged, efficient drive for the main Worthington pumps.



TOUGH OPERATING CONDITIONS encountered in the digester control room are met by totally enclosed G-E 7½-hp Tri-Clad motor driving flushing water and scum-breaking pump.



EFFICIENT DRIVE for the effluent flushing water pump is provided by a vertical 10-hp G-E Tri-Clad* motor. In the rear two smaller Tri-Clad motors drive elutriation water pumps.

ENGINEERED to meet exact requirements of the Norwalk plant, G-E metal-clad Cabinetrol* panel provides centralized control and instrumentation needed in the main pumping building.

* *Reg. trade-mark of General Electric Co.*

CLEAN WATERS to Long Island Sound

G-E equipment helps city increase plant pumping capacity and clean up recreation areas

The 25-year-old sewage treatment plant in Norwalk, Connecticut, was recently rebuilt to meet the demands of a substantial population increase. The old facilities were expanded to a capacity of 22.5 mgd and are now large enough to handle more safely all the city's waste. With this new plant, Norwalk has met the need for year-around protection of Norwalk Harbor oyster beds and has helped keep Long Island Sound resort areas safer for bathing and recreation.

Consulting engineers Metcalf & Eddy, electrical contractor County Electric Company, and general contractor De Force Construction Company worked with G-E application and field-service engineers in specifying and installing the electrical equipment.

SPECIALISTS IN SEWAGE-PLANT ELECTRIFICATION, G-E application engineers are ready to work with **your** engineers, consultants, and contractors. Contact your local G-E Apparatus Sales Representative early in the planning stage. 666-85

Don't miss the premier showing of the 1954 edition of CLEAN WATERS—G.E.'s "More Power to America" full color, non-commercial movie on America's water pollution problem—at the annual convention of the Federation of Sewage and Industrial Wastes Associations, Cincinnati, October 11-14.

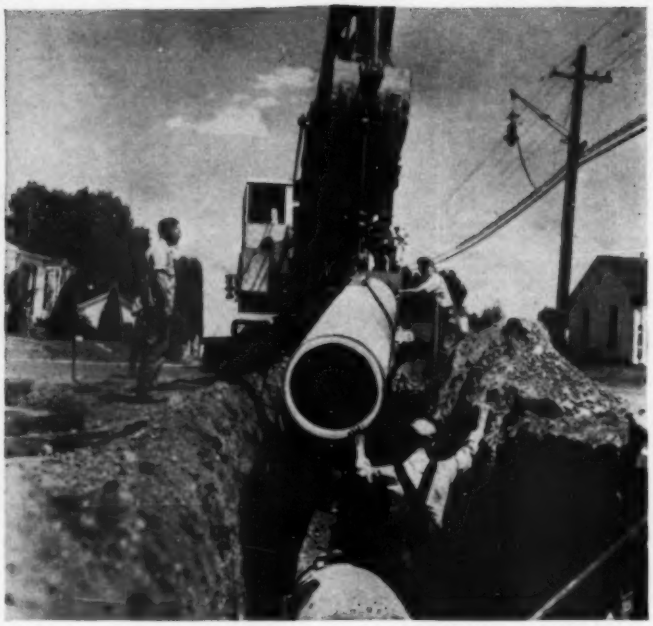
Engineered Electrical Systems for Sewage Plants

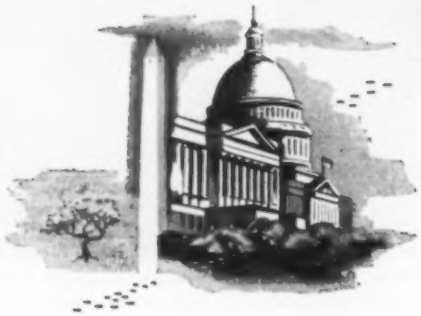
GENERAL ELECTRIC

WASHINGTON, D. C.

PREFERS

Concrete Pressure Pipe





The District of Columbia, home of the Nation's capitol, recognizes the advantages of concrete pressure pipe. From 1925 to the present, over 175,000 feet of concrete pressure pipe have been installed in this congested 69 square mile area. Pipe diameters range from 20″ to 78″, with heads from 70 up to 450 feet. A substantial part of this footage is in use in the Washington, D. C. distribution system.

Washington engineers consider economy and length of service of primary importance when specifying water pipe . . . also, high carrying capacity, and ease of installation. Because concrete pressure pipe meets these and other exacting requirements, it has been selected time and again for new supply mains and extensions to the distribution lines.

If your community is planning additional water lines, or replacements for old lines, check into the advantages of concrete pressure pipe. It is available in sizes from 12″ to over 12′ in diameter, for high or low heads, and can be installed to fit your individual requirements.

Member companies are equipped to manufacture and furnish concrete pressure pipe in accordance with established national specifications and standards.

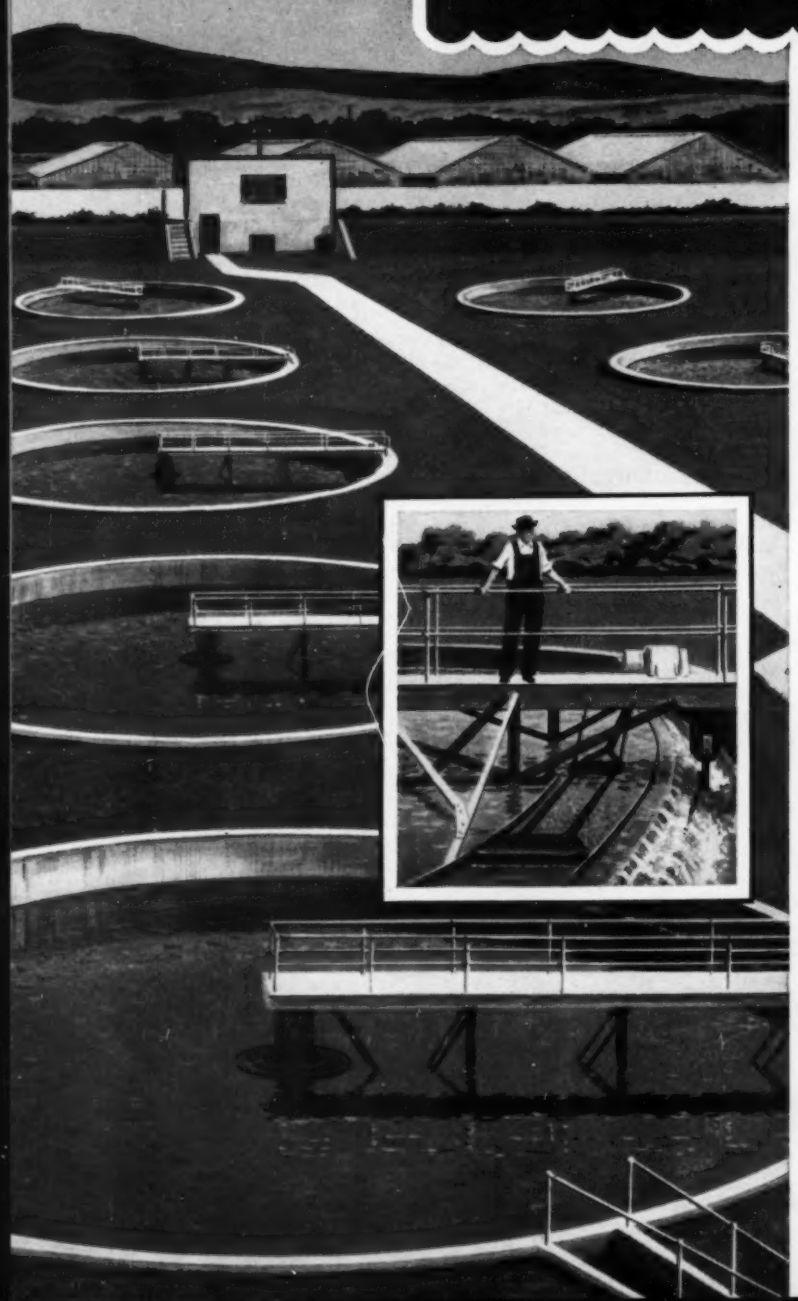
Concrete Pressure Pipe

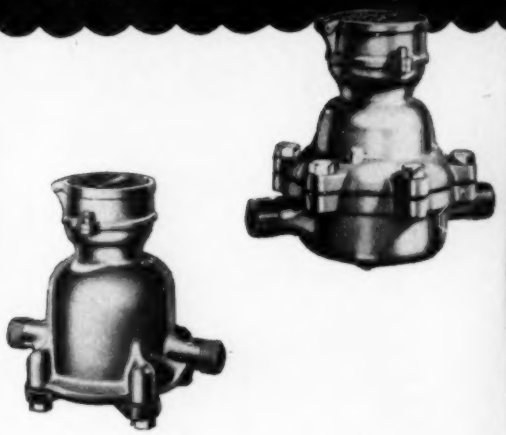
WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

Water is vital...

BADGER meters conserve it BETTER!





SANITATION is so vital to life that a city of three-quarters of a million people actually uses 134,000,000 gallons of water daily! In thousands of communities, famous Badger meters make certain that homes and industrial projects get their fair share of the supply . . . pay only for the water they use. Badger meters measure water precisely . . . help eliminate waste . . . make water departments more efficient and self-supporting. And, as waterworks men verify, Badger meters do the job dependably . . . serve for years with little or no attention.

BADGER
Water Meters

Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measures the water of the world"

Hydro-Trencher puts the squeeze on tough soil!

Working in conditions like this won't slow down the Oliver 88WT Hydro-Trencher. It digs through rocky soil, roots or hard clay fast and clean. Hydraulic down pressure does all the work. The bucket is *forced* full in the toughest going. Two completely separate hydraulic circuits keep pressure on every maneuver, even when you perform two operations at once. You've got working power all the way—to speed your work, to boost your production.

A one-man rig, the 88WT is ready to work or move in a moment. Its half-yard capacity and rubber-tired mobility cut hours and dollars from any job. Its compact design and delicate hydraulic control let you work next to pipes, walls, foundations, without fear of damage. The rugged, hydraulic stabilizer blade holds the unit level and steady, and also doubles as a backfiller blade. And here's a bonus feature, turn the trenching bucket around, in minutes you have a swing loader with all the power features of the trencher.

For more profit, put the squeeze on your trenching or loading operations with the Oliver 88WT Hydro-Trencher. Visit your Oliver Industrial Distributor for a demonstration.

OPERATING FEATURES
OLIVER 88WT HYDRO-TRENCHER
AND SWING LOADER COMBINATION

- One-half yard bucket
- Digs to 10 feet (12 feet with optional boom cylinder)
- Loads to 10½ feet (12 feet with optional loading bucket)
- 200° boom swing

THE OLIVER CORPORATION

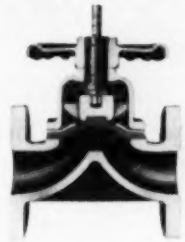
400 West Madison Street, Chicago 6, Illinois

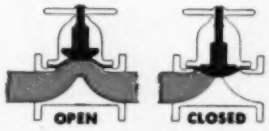
a complete line of industrial wheel and crawler tractors

GRINNELL-SAUNDERS DIAPHRAGM VALVES

In hundreds of installations, the maintenance-saving design of Grinnell-Saunders Diaphragm Valves has accounted for important economies of labor and money. The only part that will in time need replacement is the diaphragm, and depending on the type of service, it may last for years. To replace it takes only a few minutes. You merely remove the four bolts holding the bonnet, leaving the body in the pipe line . . remove the worn diaphragm, insert the new diaphragm . . replace the bonnet and bolt it down. No refacing or reseating required . . no packing glands to demand attention.

Originally perfected for air and water service, Grinnell-Saunders Diaphragm Valves are now widely specified for many other applications. They greatly reduce replacement and maintenance expenses, especially in lines where corrosion, abrasion, contamination, clogging and leakage can be costly factors. Write today for the Grinnell-Saunders Diaphragm Valve Catalog . . and assign your next valve problem to Grinnell.





Other Important Features:

Diaphragm absolutely isolates working parts from the fluid stream

Diaphragm lifts high for full, streamline flow in either direction

Diaphragm presses tight for positive closure

Body, lining and diaphragm materials to suit service

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WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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MT. VERNON, OHIO

Mt. Vernon Sewage Plant

(Completed in 1953)

ALDEN E. STILSON & ASSOCIATES, Ltd.

Consulting Engineers

COLUMBUS, OHIO

1 Vertical installation of 20" x 10" Builders Venturi Tube on discharge side of raw sewage pump . . . Chronoflo Transmitter at lower left. Plant also uses a Builders Flo-Watch Venturi Meter for Sludge Measurement . . . and Omega Universal Feeders for alum, Ferri-floc, and hydrated lime.

2 Builders Chronoflo Electric Receiver for totalizing, indicating, and recording raw sewage flow. Instrument is conveniently located in control building lobby.

With the completion of this 3.3 MGD Sewage Plant by Mosser Construction, Inc. of Fremont, Ohio, Mt. Vernon has been able to abandon its obsolete and inadequate Imhoff-type plant. The treatment process includes primary treatment and pre-aeration, supplemented by chemical precipitation during Summer months. Sludge is disposed by separate digestion and by sludge drying beds.

The plant employs the latest in Builders Metering Equipment to promote uninterrupted and efficient plant operation. For details on Builders Equipment engineered specifically for sewage plant service, address Builders-Providence, Inc., Providence, Rhode Island.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

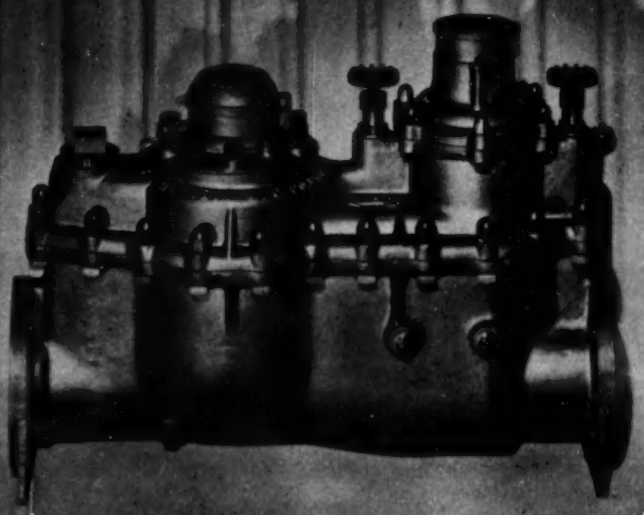
BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS

This Hersey Compound Water Meter

HAS NEVER BEEN EQUALED!

. . . There is no substitute for our 69 years of progressive experience in designing and building water meters.



HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

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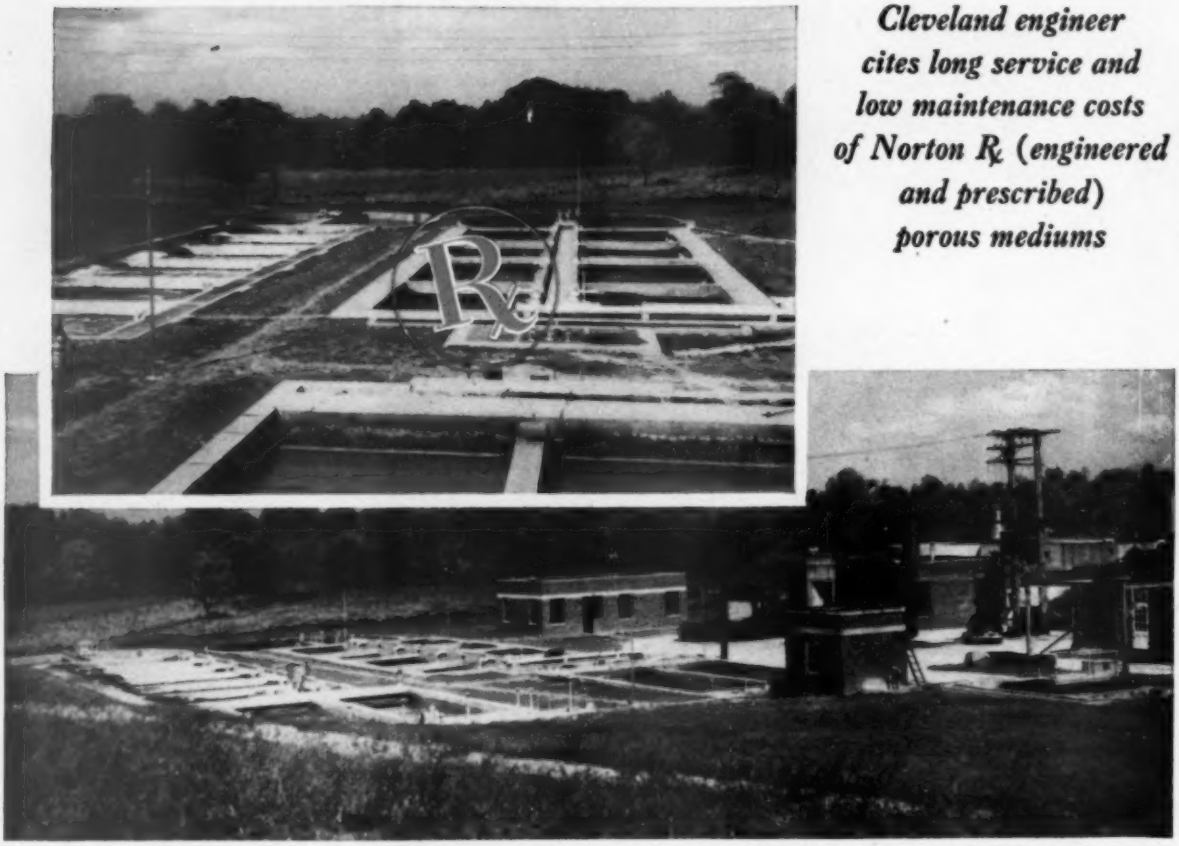
"We think highly of Norton plates"



Cleveland engineer cites long service and low maintenance costs of Norton Rx (engineered and prescribed) porous mediums

Plates In This Berea, Ohio, Sewage Plant are from the famous Norton line of Rx porous mediums, engineered and prescribed for many important uses. Smaller photo shows close-up of tanks.

"We think highly of Norton plates. In fact, your plates at Berea, Ohio, installed in 1937 are still intact and were cleaned for the first time in 1951."

This message from Rollin F. MacDowell of Rollin MacDowell & Associates, Consulting Engineers of Cleveland, describes a specific installation where Norton Rx porous mediums insure top performance and keep maintenance costs down.

All Norton ALUNDUM* porous mediums are made with the patented *controlled structure* process that assures even distribution of pores — for uniform diffusion — in the size and open-pore ratio that best meets your needs. And Norton tubes have the seamless construction that provides unobstructed diffusion over their entire area and enables faster, more thorough cleaning.

Other Big Advantages

of Norton Rx porous mediums include exceptional resistance to breakage and chipping and their ability to stand up under cleaning with acid. They're made in a wide range of sizes . . . tubes and discs for aeration in activated sludge treatment . . . tubes for diatomite filters in swimming pools . . . plates for rapid sand filters in water filtration.

Get The Whole Story

Norton illustrated booklets bring you helpful charts, tables and important information on your own use of porous mediums. Ask your Norton Representative, or write direct to NORTON COMPANY, 229 New Bond St., Worcester 6, Mass.

NORTON

POROUS MEDIUMS

Engineered . . . Rx . . . Prescribed

Making better products . . . to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Vinyl coating users agree . . .

YOU GET

MORE MILS PER GALLON WITH AMERCOAT 33

Amercoat's higher solids content gives you a thicker, heavier coating—more mils for every gallon applied.

THIS MEANS YOU SAVE MONEY TWO WAYS ON MAINTENANCE PAINTING

Lower Material Cost. You save on material because it takes fewer coats of AMERCOAT 33 to build the required film thickness.

Lower Labor Cost. You save on labor because fewer coats mean fewer man hours for application–less down time, too.

In addition to more mil thickness per gallon, you get more protection per gallon. AMERCOAT 33 is formulated specifically for maximum chemical resistance and for severe weathering conditions. In major industries from coast to coast – chemical, petroleum, pulp and paper, food, and many others – maintenance engineers look to AMERCOAT 33 for low cost, long lasting protection for all types of steel or concrete structures.

Amercoat pioneered the development of protective coatings especially designed for severe corrosion problems. Today it is the only organization that offers you... a complete line of corrosion resistant coatings...nationwide distribution... trained technical men to give you on-the-job assistance throughout the United States and Canada.

Amercoat CORPORATION
Dept. F,
4809 Firestone Blvd.,
South Gate, California

CHICAGO, ILL. • KENILWORTH, N. J. • JACKSONVILLE, FLA. • HOUSTON, TEX.

Write today for the AMERCOAT 33 Technical Bulletin which gives a complete description of the coating's chemical and physical properties.

You can't afford to forget...

That cast iron pipe lasts over 100 years—

That cast iron pipe is inherently stronger, tougher, uniform in quality—

That cast iron pipe offers low installation costs, plus savings throughout its life because of low maintenance costs—

That cast iron pipe's long life and economy saves millions of tax dollars—

That cast iron pipe is the standard conduit for carrying water underground—

That before you experiment with substitutes in your waterworks system, you should study these facts and recognize the guarantee they offer: only cast iron pipe gives you a *proven record* of economy through *decades of use!* And experienced city officials have, for over three-quarters of a century, chosen Clow Cast Iron Pipe as the finest made. They know Clow offers consistent high quality, coupled with excellent service and fast delivery. They know *centrifugally cast* Clow Pipe offers longer life, greater economy and that it meets all currently approved specifications now in existence. Write today for complete, factual information.

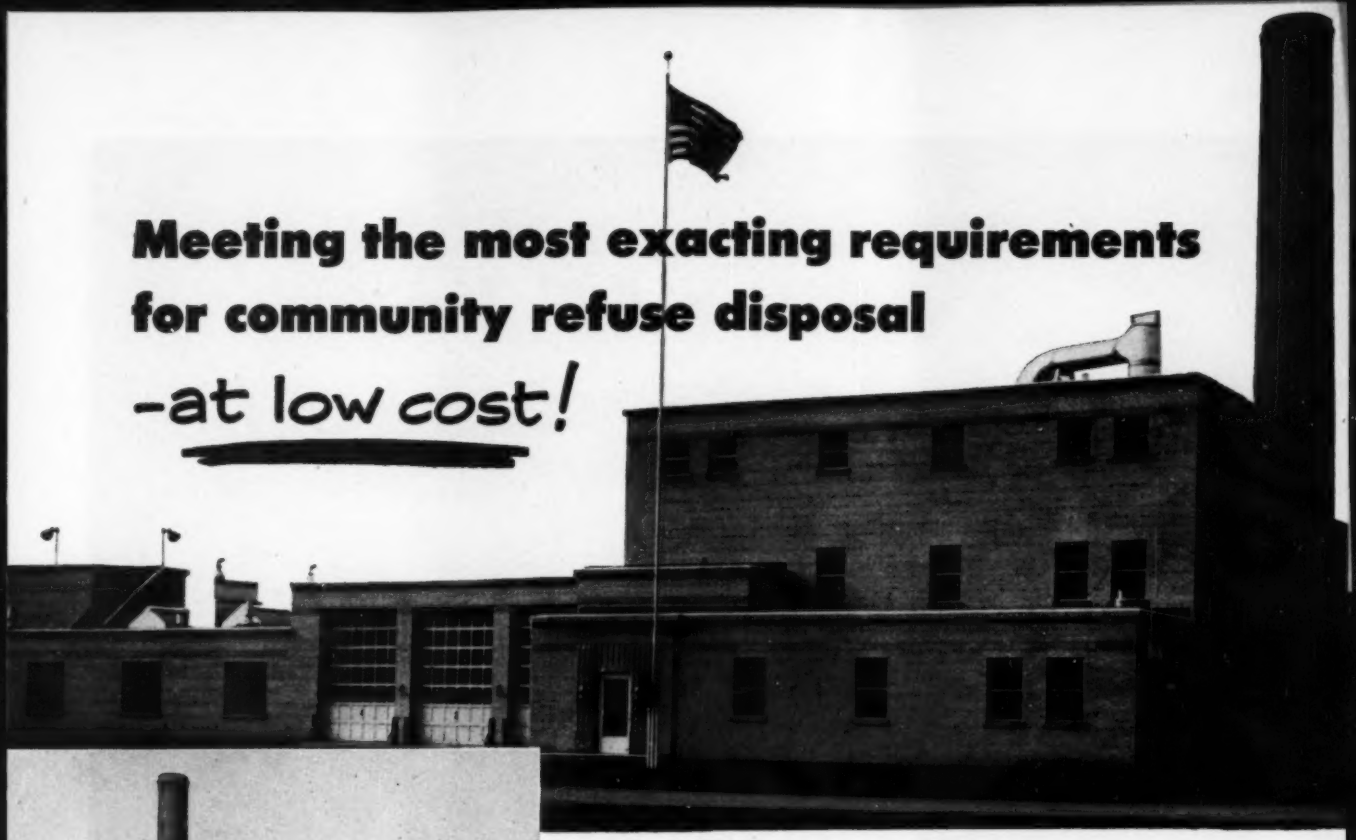
JAMES B. CLOW & SONS

201-299 North Talman Avenue • Chicago 80, Illinois

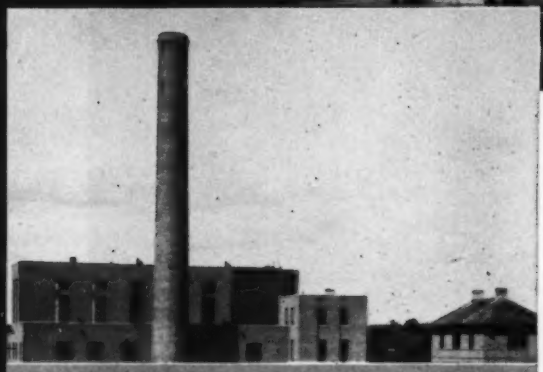
and their National Cast Iron Pipe Division, Birmingham, Ala.
Subsidiaries: Eddy Valve Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Iowa

Meeting the most exacting requirements for community refuse disposal

-at low cost!

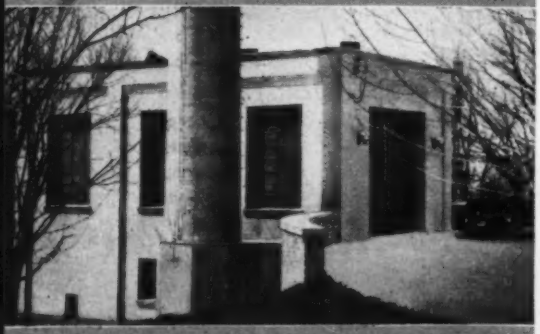


Fond du Lac, Wisc. Capacity 90 tons per 24 hours



Stamford, Conn. Capacity 225 tons per 24 hours

Darien, Conn. Capacity 60 tons per 24 hours



Little Falls, N. Y. Capacity 30 tons per 24 hours

PITTSBURGH • DES MOINES

High Temperature

REFUSE INCINERATORS

Pittsburgh-Des Moines Incineration Plants reduce collected garbage and refuse to sanitary ash in minimum time—at minimum cost per ton—and without offense to surrounding areas. These modern units feature controlled *high-temperature* operation, providing freedom from smoke or odor, and are built in a complete range of capacities for communities of every size.

MECHANICAL STOKING

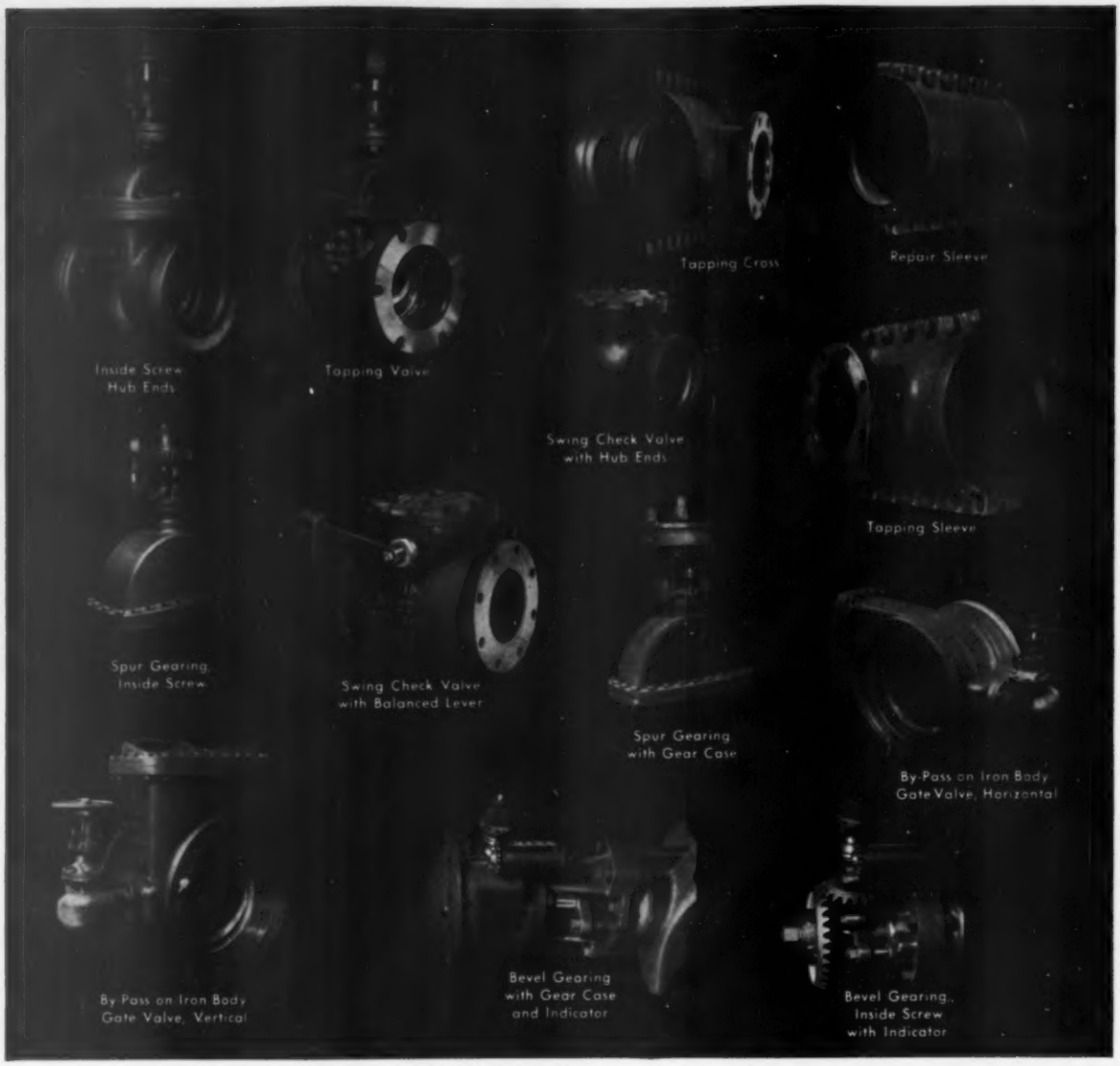
Now available for new and existing P-DM Incinerators, mechanical stoking system assures top operating efficiency, enlarges plant capacity, reduces man hours and labor, lengthens refractory life. Write for details and consultation, without obligation.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) ..... 3418 Neville Island
NEWARK (2) ..... 218 Industrial Office Bldg.
CHICAGO (3) .. 1222 First National Bank Bldg.
LOS ANGELES (48) ..... 6399 Wilshire Blvd.
DES MOINES (8) ..... 919 Tuttle Street
DALLAS (1) ..... 1223 Praetorian Bldg.
SEATTLE ..... 526 Lane Street
SANTA CLARA, CAL. ..... 625 Alviso Road


Inside Screw Hub Ends
Tapping Valve
Tapping Cross
Repair Sleeve
Swing Check Valve with Hub Ends
Tapping Sleeve
Spur Gearing, Inside Screw
Swing Check Valve with Balanced Lever
Spur Gearing with Gear Case
By-Pass on Iron Body Gate Valve, Horizontal
By Pass on Iron Body Gate Valve, Vertical
Bevel Gearing with Gear Case and Indicator
Bevel Gearing, Inside Screw with Indicator

DARLINGS...good for YOUR system

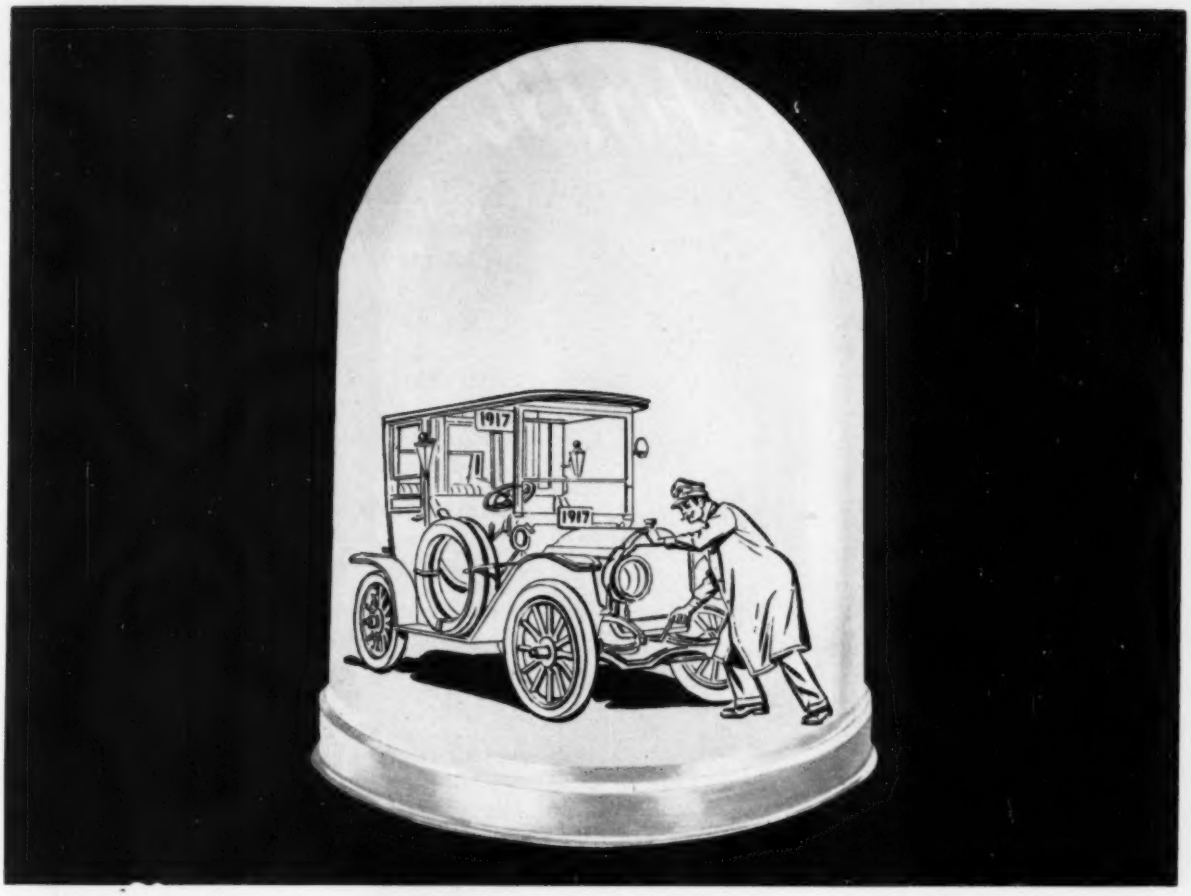
TRADE DARLING MARK

THIS composite picture gives you a rough idea of the broad range of Darling valves and allied products engineered for water distribution systems. What you cannot see here, naturally, is the unexcelled Darling quality—carefully controlled from Darling's own foundry all the way through final assembly and test. Nor can you "picture" performance advantages such as offered only by Darling's fully revolving double disc gate valve principle. For items such as shown here . . . and Darling's revolutionary B-50-B hydrants . . . it will pay you to check with Darling.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.



how much does it cost... to "crank" an old chlorinator?

The automobile self-type starter isn't news any more—nobody ever cranks a car these days. "Cranking" an old-style chlorinator is equally out-dated.

The F&P mechanical, instrument-type chlorinator is sweeping the country, sales mount month by month. Why? Because municipality after municipality, consulting engineer after consulting engineer, reports the same facts: F&P chlorinators are lower in first cost, are easier to handle, because they are so simple in design, so light in weight, so modern in construction. More important, however, it is always stressed that F&P chlorinators require practically no maintenance, practically no spare parts.

We claim that if you are operating a chlorinator that has a bell jar on it *you need a new chlorinator*. You are "cranking" an old, costly, inefficient chlorinator. Everybody knows that dry chlorine is not corrosive—but that as soon as you put the chlorine in contact with water or water vapor it becomes corrosive. That's what the water tray types of chlorinators do—put dry, non-corrosive chlorine in contact with water and make corrosive vapor out of it. It's not engineering sense and the way to avoid it—and the resulting expensive maintenance—is to get F&P *mechanical, instrument type* chlorinators.

Don't refrain from writing us because you don't need additional chlorinating capacity right now. Moreover—if it is time for a major overhaul or a rebuilding of your bell jar chlorinator, let us quote you for doing this work. We will give you what you may not have gotten previously—a firm price for doing the job before we start on it. The price will be a reasonable one, but we'll also quote you a price for replacing the chlorinator and if you want to spread the cost of the new one by time payments or if you want a lease arrangement, you can have it. Chances are you cannot justify further overhaul or further rebuilding—even at our *fair* price for doing the work.

complete process instrumentation

FISCHER & PORTER CO.

194 Fischer Road, Hatboro, Penna.

18 YRS. EXPERIENCE SUCCESSFULLY MANUFACTURING CHLORINE FLOW METERING EQUIPMENT

LA 1010

Valves Installed in 1907 Never Out for Repairs

VALVE SERVICE RATINGS

SUITABILITY:	Couldn't be better
FEATURES:	Non-jamming double disc
MAINTENANCE COST:	Almost nil
SERVICE LIFE:	46 yrs. – Still O.K.
OPERATING RESULT:	Economical, trouble-free service
AVAILABILITY:	Regular item – Current No. 2485

In the Brackenridge Borough, Pa., municipal water plant, having forty large Crane iron body double disc gate valves on services up to 90 pounds pressure.

THE CASE HISTORY

How wisely Brackenridge Borough water utilities engineers chose valves in 1907 is self-evident. Today, 46 years later, the forty original Crane valves installed are still on the job—still giving completely satisfactory service. What's more, except for occasional repacking, none of the valves have needed repairs of any kind. And indications are, many years of service remain in the valves.

Valves that set performance records like this aren't bought on price alone—it's assurance of quality that counts in buying. That's thrifty buying—the only way to get best value.

THE VALVE

Highly developed for extra durability and dependability, today's Crane A.W.W.A. valves help water utilities operate efficiently now and in the future. Available in flanged or hub ends up to 36-in. size, these valves permit complete standardization. See your Crane Catalog or your Crane Representative.

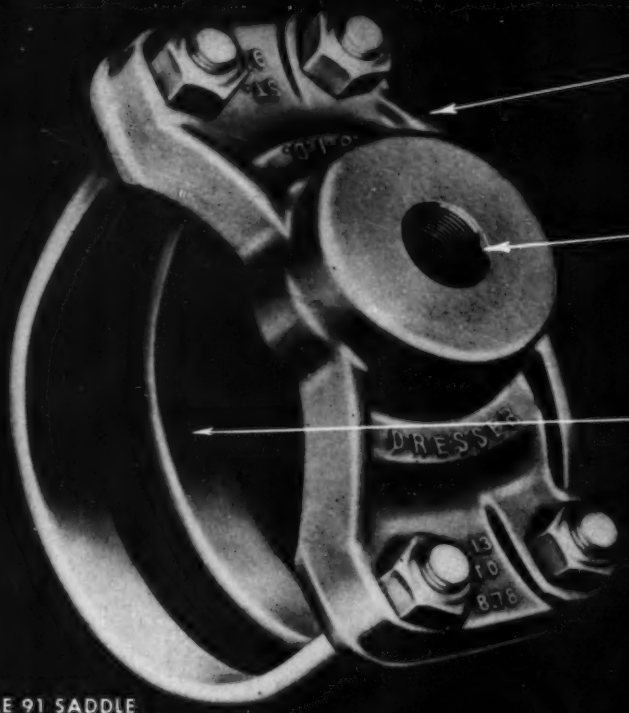
THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

NOW AVAILABLE



STYLE 91 SADDLE
(8" ID)

HEAVIER CONSTRUCTION
Bodies designed with heavily reinforced sections, ruggedly constructed from Grade A malleable iron.

FULL TAPPING RANGE
Available with Corporation Stop Thread or IPS Thread taps to 2 inches in size. Large boss insures full threads.

FLAT STEEL STRAPS
Accurately shaped, high tensile steel straps conform to pipe. Wide, flat surfaces prevent cutting or crushing.

FITS RANGE OF PIPE
Fits steel, cast iron and asbestos-cement pipe, within size range clearly marked on each saddle.

NEW DRESSER SERVICE SADDLE

...designed for long, rugged service

The new Dresser Style 91 Service Saddle has been carefully designed for maximum dependability, economy and ease in making service connections.

The body of the saddle is heavily constructed with a Dresser gasket of time-proven Grade 27 compound securely cemented in place. Cold-rolled threads give the bolts greater strength and added resistance to corrosion.

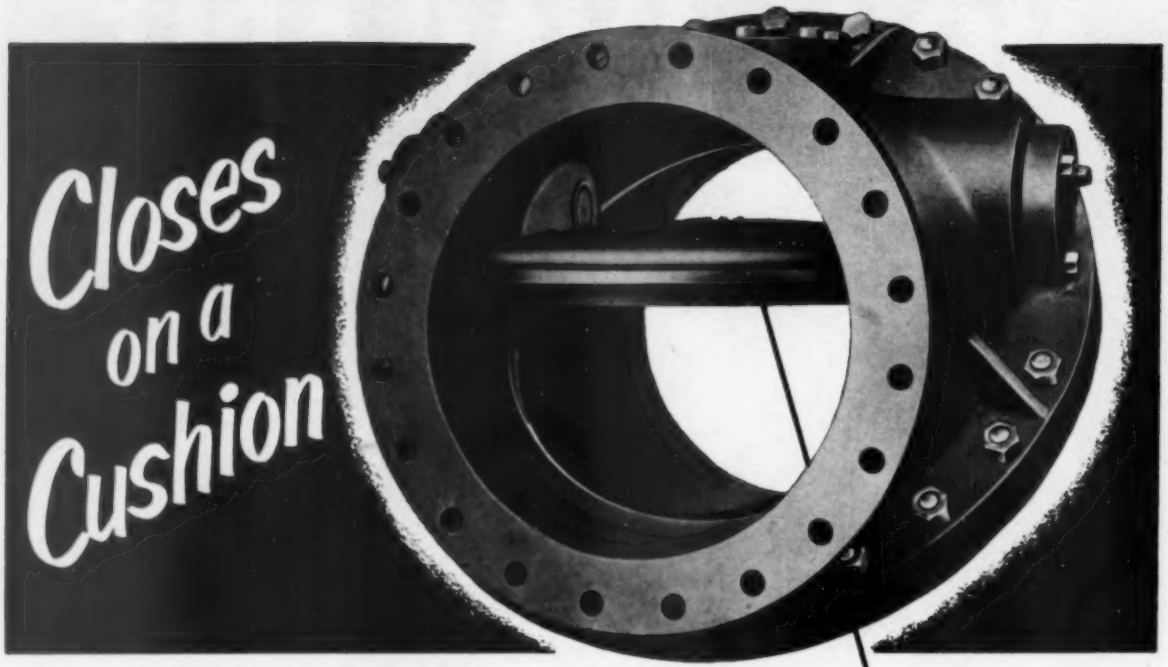
Style 91 Saddles are heavily galvanized or protected with Dresser's new plastic dip. This coating covers all threads as well as saddle surfaces, has dielectric strength, will not "plate out". Saddles are packaged for convenient handling and storage.

Order a stock of Dresser's new, economical Style 91 Saddles from your local waterworks supplier today, or write us!

DRESSER®

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales Offices also in: New York, Philadelphia, Chicago, Toronto.

Chapman's Tilting Disc Check Valve

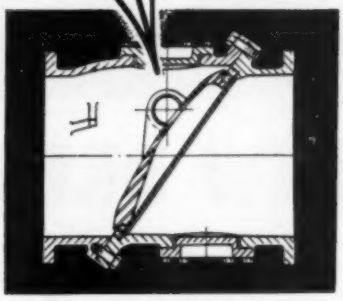


...for low cost, slam-free operation

Balanced pressures *cushion* the movement of the disc in Chapman's Tilting Disc Check Valve. The valve closes quickly but quietly, in all but unusual piping arrangements. There's no slamming to damage pipe-line joints or the valve itself. And *drop-tight* closure eliminates sliding wear on the disc and seat.

In the open position, the "airfoil" designed disc rides firmly against stops, without swinging or fluttering. That's why the hardened extra-large hinge pins give extremely long wear. And the absence of turbulence is one reason why head loss through Chapman's Tilting Disc Check Valve is lower than through any other type of check valve.

Low head loss, increased wear resistance and freedom from destructive slamming make Chapman's Tilting Disc Check Valves unbeatable for almost every installation. Write for Catalog No. 30 today.



Here's why
CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

THE CHAPMAN VALVE MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

There's only one sensible way to fight sewage corrosion: Stop it before it starts. Coating your pipe, tanks and equipment with *Pitt Chem* Tar Base Coatings before you put your plant into operation is like buying an insurance policy against corrosion problems for many years to come. Pitt Chem offers you three outstanding benefits:

1. **Longer-lasting protection.** Pitt Chem stands up to sewage corrosion 7 to 10 years longer than ordinary paints. Yet it costs no more per gallon.
2. **Economical application.** No special paint crew is required. Your own men can apply coating after a few simple instructions.
3. **Durable Bond to most materials.** Pitt Chem forms an excellent long-lasting bond with metal, masonry, cement and stone.

Add up these unique benefits and you'll agree: *No other material does such a complete job of protection at so little cost.* ● A *Pitt Chem* corrosion control booklet will gladly be sent to you on request.

WAD 4958

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

PROTECTIVE COATINGS DIVISION
PITTSBURGH
COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

Proud "city fathers" must look to the future, too!

IOWA hydrants and valves are never "orphans"!

No need to worry about the future of your city's water system when you choose *Iowa*. You know you're buying a reliable product from a reliable firm and that there will always be replacement parts, when and as needed. What you may not know, though, is this . . . *Iowa* hydrants are easily and economically serviced—even by new employees without special training.

Below are additional facts to keep in mind when you plan to expand or replace any part of your city water works.

IOWA HYDRANTS

Provide full, truly unrestricted water way.

Open *with* the pressure for faster water delivery.

Close *against* the pressure to eliminate water hammer, provide flushing action.

Assure positive drainage.

Are available for any type of connection.

All working parts removable through top—no digging or special tools required.

Meet all A.W.W.A. specifications.

IOWA GATE VALVES

Double disc, parallel seat.

Positive wedging action for efficient, no-leak closing.

Gates hung loosely from stem nut—no binding.

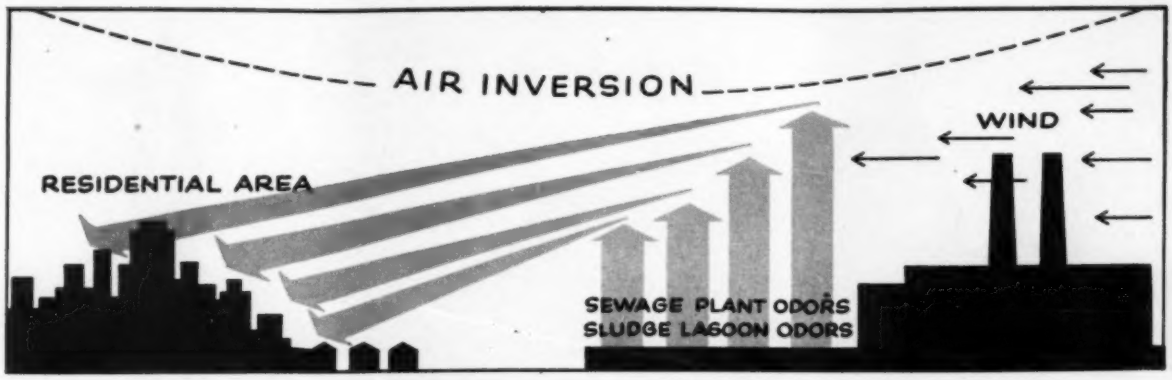
Rugged, time-proved design means long life, low service costs.

Available with bell, flange, or mechanical joint connections to fit any existing or planned installation.

Meet all A.W.W.A. specifications.

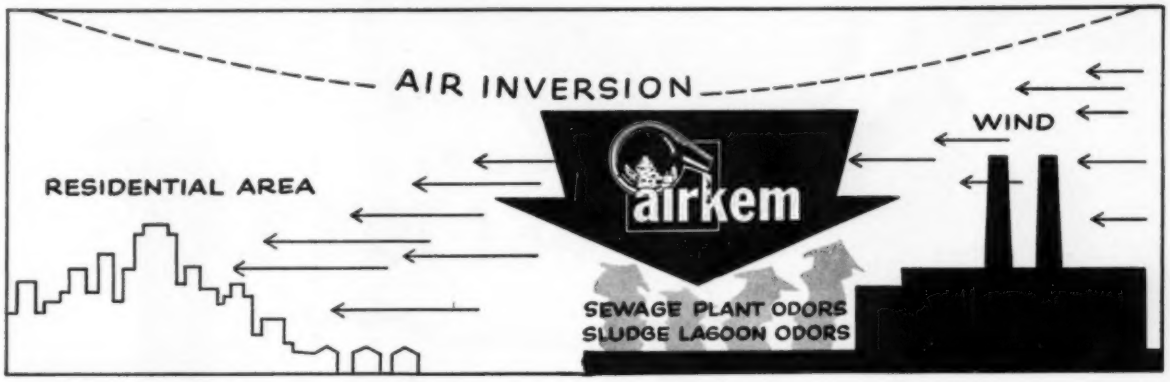
The best insurance policy is the order that specifies IOWA!

IOWA VALVE COMPANY
A Subsidiary of James B. Clow & Sons
201-299 NORTH TALMAN AVENUE
CHICAGO 80, ILLINOIS



A multi-million-dollar sewage treatment plant was in trouble. Despite "care, cleanliness and chlorine," unpleasant odors were invading the homes of 30-thousand nearby residents.

AIRKEM took this problem and solved it!



Stumped for an economically-sound solution, officials called in Airkem's Industrial Odor Service. After carefully analyzing the problem, the odor trouble-shooters installed simple, low-cost equipment for dispensing a new Airkem product formulated specifically to counteract airborne sewage odors.

Results were immediate and gratifying. The odors were gone. And not only were good relations re-established with the neighbors, but the plant staff was pleased as punch with their improved working conditions. Best of all, the results had been accomplished at moderate cost and without affecting plant operation.

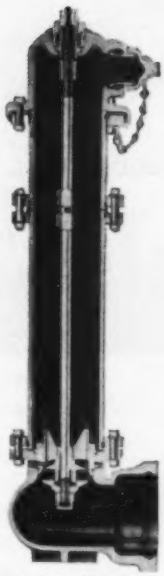
If odors are damaging your plant's public relations, it will pay you to call in Airkem's Industrial Odor Service specialists. They have the low-cost answers to sewage odor problems of widely differing types and degrees of complexity. And behind them are the facilities of the world's largest laboratory devoted exclusively to the study and solution of odor problems.

Consultations are strictly confidential, incur no obligation. Call your local Airkem representative now (he's listed in your phone book), or write today to Airkem, Inc., 241 East 44th Street, New York 17, N. Y.

See Airkem's Miniature Sewage Plant in Action! Booth #48, Annual Convention of the Federation of Sewage & Industrial Wastes Association— Cincinnati, October 11th through 14th.

airkem ODOR COUNTERACTANTS

FOR INDUSTRIAL • MUNICIPAL
INSTITUTIONAL • COMMERCIAL USE



The R. D. Wood Hydrant can be furnished with breakable flange and stem coupling at extra cost. Both are built to break with a heavy blow. This saves the hydrant itself and makes repair quick and easy.

The R. D. Wood Swivel Joint Hydrant: All internal parts, including drain valve seat, removable through barrel • all-bronze stuffing box • completely revolving head • compression-type valve, cone shaped to prevent water hammer • automatic drain valve • bronze main valve seat screws directly into elbow with straight, not tapered threads • mechanical-joint pipe connections if specified.

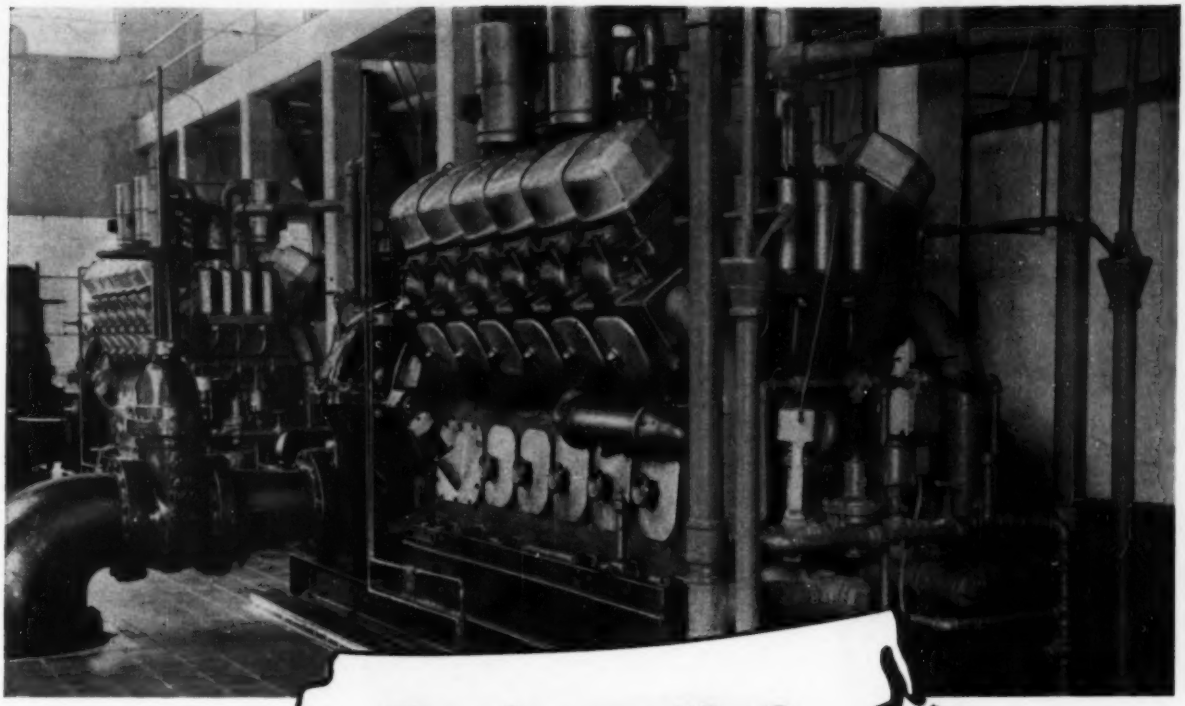
Solidly Built

• The R. D. Wood Swivel Joint Hydrant is designed to provide maximum reliability at lowest cost consistent with assured delivery of water at full pressure. It is solidly built and of the finest materials. Every point where rust and corrosion might interfere with operation is protected by at least one bronze surface.

R. D. Wood Swivel Joint Hydrants

Public Ledger Building, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves



Durham, N. C. counts on LE ROI L3460's

to provide dependable emergency power for water-pumping service

Here's what officials of Durham did, when they had to scrap their obsolete steam-engine-driven pumps: They replaced them with two modern pumping units that were powered by Le Roi L3460 engines.

There are five sound reasons why their selection of *Le Roi* was a wise one:

1. Le Roi engines are built by a manufacturer with many years of experience in meeting the specialized power requirements of heavy-duty service.
2. Le Roi engines are the most powerful engines in the medium-speed, heavy-duty class — yet are compact and call for relatively low investment.
3. Le Roi engines have the weight and stamina to withstand the punishment of continuous operation without costly breakdowns.
4. Le Roi engines are precision-machined for smooth operation, longer life.
5. Le Roi engines have plenty of power in reserve to handle the heavy loads.

These are reasons why many municipalities insist on Le Roi power for pumping, for generating electricity, for standby service.

Enjoy dependability you can count on — economy that helps lighten the tax load in your community. Use reliable low-cost Le Roi power. Le Roi engines are available in sizes from 20 to 600 hp —custom generator sets in sizes from 50 to 300 KW. They operate on no-cost sewage gas, natural gas, butane or gasoline.

Write today for detailed information

LE ROI

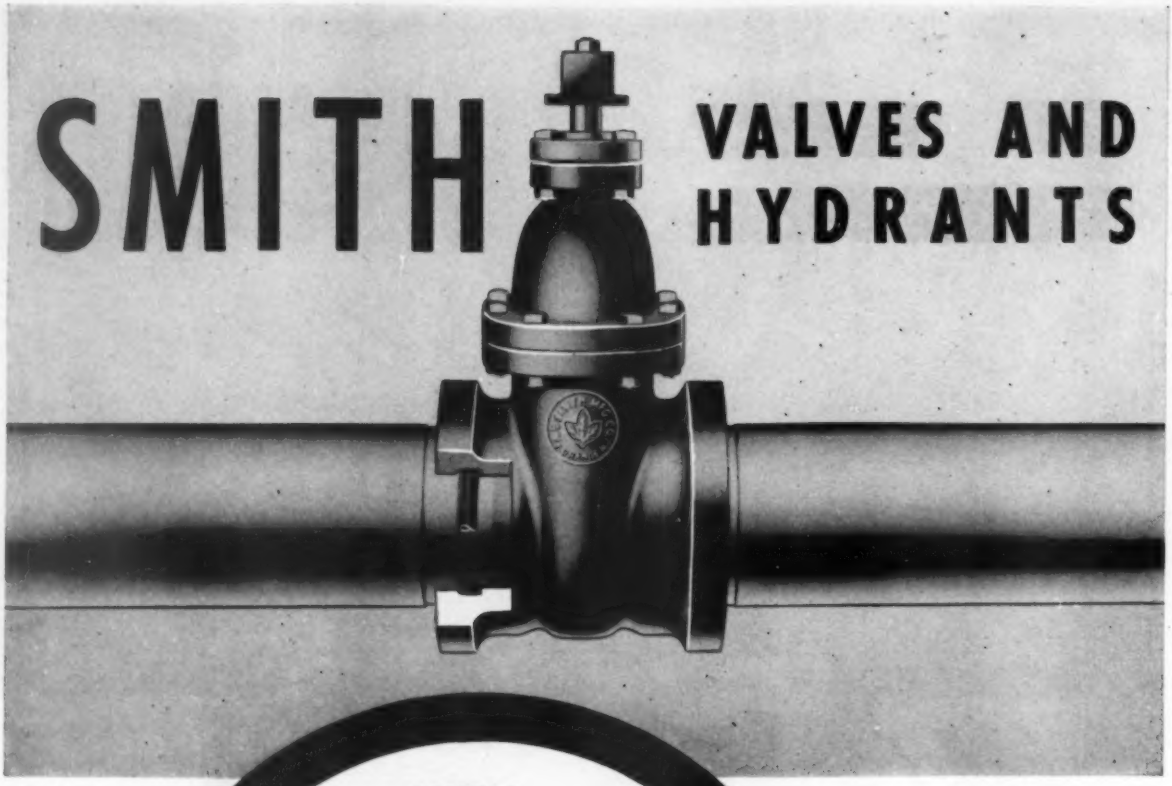
E-98

LE ROI COMPANY

Dept. WA-10 • 1706 S. 68th Street • Milwaukee 14, Wis.

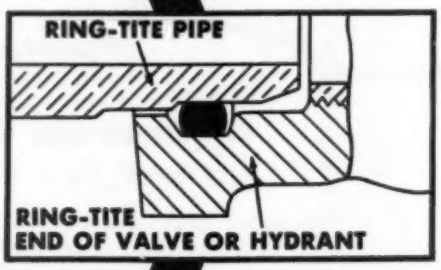
Plants: MILWAUKEE CLEVELAND GREENWICH, OHIO

SMITH VALVES AND HYDRANTS



WITH

NEW RING-TITE JOINT.....



Smith A. W. W A. Specifications Gate Valves (4" through 12") and Smith Fire Hydrants (with 4" or 6" connections) are now available with Ring-Tite joints for direct connection to Johns-Manville Class 150 Transite Ring-Tite Pipe. No special fittings or extra joint material needed. Installation is quick, easy, economical, and joints can be made in any weather and in roughest terrain. Tight, flexible joints are assured. At low pressures, radial compression of rubber ring seals the joint; increasing pressure wedges the rings—the higher the pressure the tighter the seal. For complete details write for Bulletin RT 53.

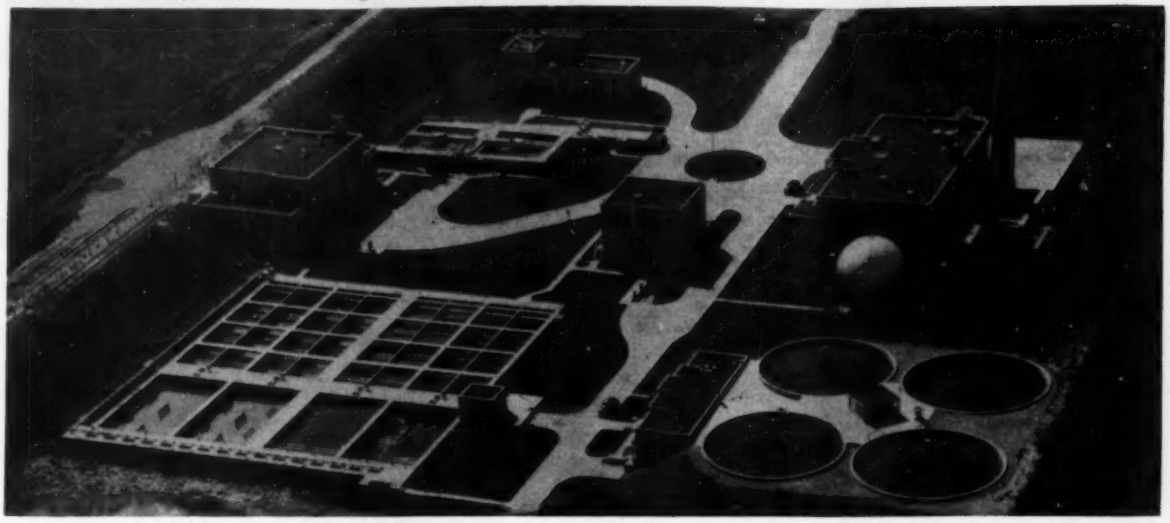
49

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

"Little Miami"—first of 4 new sewage treatment plants for Cincinnati's metropolitan area



Cincinnati leads Ohio River clean-up program

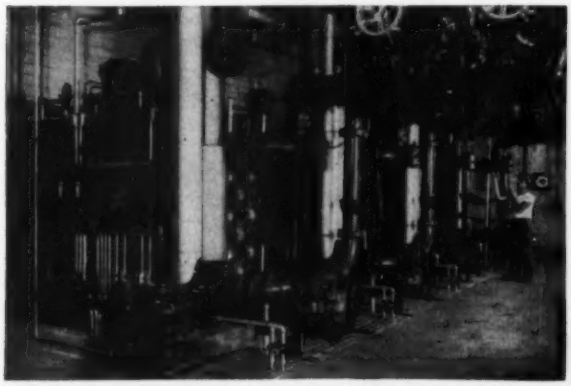
Four-plant, 154 MGD project includes PFT "Controlled Digestion"

Leading an 8-state drive for modern sewage disposal in the Ohio River Valley, Cincinnati recently completed the first of 4 sewage treatment plants to serve the entire metropolitan area. Their splendid new system has encouraged other Ohio River municipalities in this great clean-up program!

Called "Little Miami," the new 29 MGD plant adopted the following items for PFT "Controlled Digestion":

(1) *PFT Floating Covers* in the four 65′ digesters for positive scum submergence, safe utilization of gas and simplified operation.

(2) Four *PFT Cover Position Indicators* to record the liquid level in each digester.



Four No. 750 PFT Heater & Heat Exchanger Units.

(3) Four *PFT Supernatant Selectors* for automatic, continuous withdrawal of the best digester liquor, along with *PFT Gauge, Sight-Glass and Sampler* units.

(4) Four *PFT No. 750 Heater & Heat Exchanger* units to keep digesters at optimum temperatures of 90°-95° F. Fired by sludge gas *or* oil, these units cut fuel costs by utilizing all sludge gas available, automatically changing to oil as necessary. In addition to sludge heating, these units provide heat for the digester control building.

Little Miami will be followed by the 120 MGD Mill Creek plant, the largest of the group. PFT has already received extensive orders for "Controlled Digestion" equipment in the huge new plant including 12 PFT 110′ diameter Floating Covers with PFT Aluminum Prefabricated Roof Decks, and PFT Pearth Gas Recirculation Equipment and 23 PFT External Heat Exchanger Units.

Design of plants by / *Havens & Emerson, Consulting Engineers, Cleveland, Ohio*

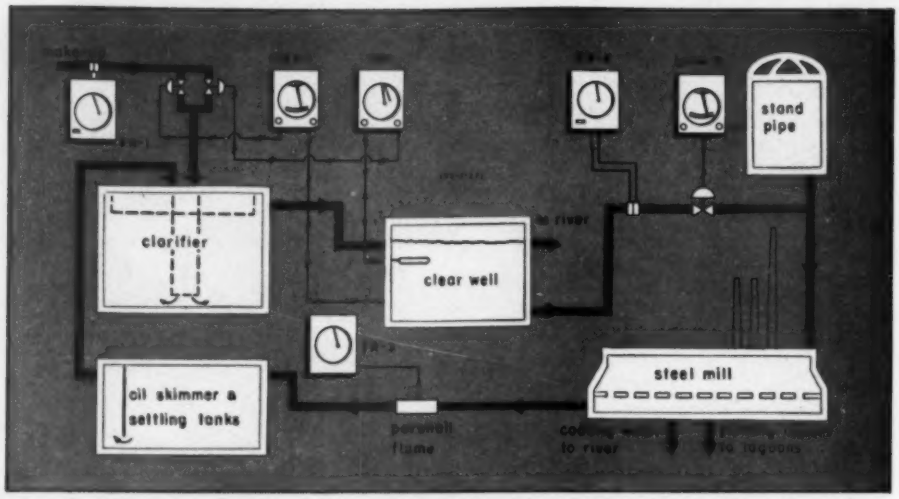
P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

4241 Ravenswood Avenue
Chicago 13, Illinois

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER



Raw water from a nearby river is fed to a clarifier, through a clear well and then to the mill where part of it is used for cooling and processing. To reduce the amount of make-up, a sizeable portion of the processing water is returned to the treating plant.

Engineered instrumentation aids economical usage of water

TWENTY MILLION gallons of water per day are used in producing steel, at Alan Wood Steel Co., Conshohocken, Pa. Treating this tremendous volume of water for plant use is a big job . . . to which Brown instruments lend valuable assistance.

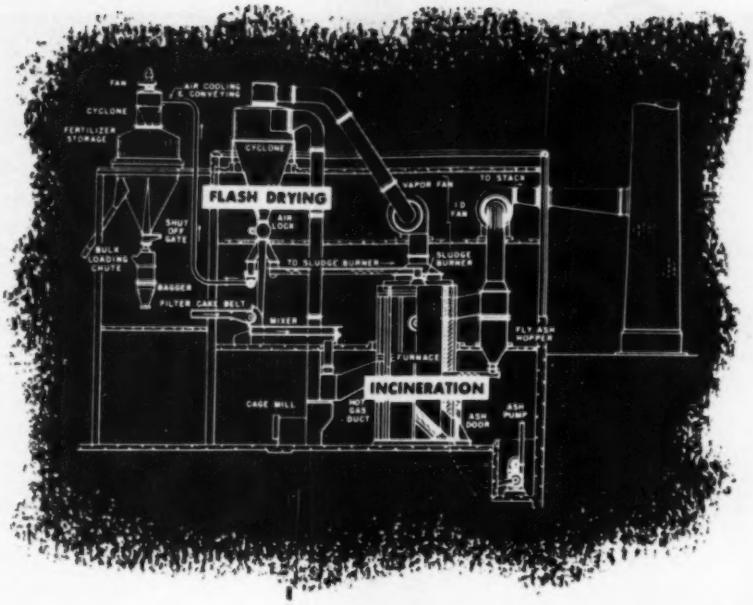
At each stage, Brown instruments keep operations in coordinated, efficient step with each other. A temperature controller on the clear well, for example, holds water temperature down to an effective value for cooling, by allowing more river water to enter the system when needed to counteract the heat of the water returned from the mill. A liquid level controller also regulates flow of make-up to maintain a preset minimum level in the clear well. Other Brown instruments work together to give a continuous, clear picture of flows, liquid levels, and pump discharge pressures throughout the treatment process.

A complete line of Brown instruments, and specialized, technical experience are ready to serve your water and waste treatment problems. Your nearby Honeywell sales engineer will be glad to discuss your applications with you and your consulting engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● REFERENCE DATA: Write for Bulletin 1188, "Measuring and Controlling Liquid Level"... and Catalog 2320, "Flow Meters"

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls



SOME FACTS ABOUT THE HEAT DISPOSAL of SEWAGE SLUDGE

Even though dried sewage sludge can often be sold at from $5.00 to $20.00 a ton – remember that is not *always* the case.

If sewage is contaminated—with grease, fiber, etc., for example—you may find the *only* thing to do is to incinerate the sludge. On the other hand, even though the sludge may not have the highest chemical analysis for fertilizer – it still can be marketed as a soil conditioner – thereby eliminating the ash disposal problem.

The C-E Raymond System of Flash Drying and Incineration is the most popular . . . most versatile on the market today. That's why you will find a C-E Raymond System to provide one or all of the following processes . . . controllably, accurately, economically:

1. **Flash Dry sludge.**
2. **Flash Dry and Deodorize.**
3. **Flash Dry and Incinerate.**
4. **Flash Dry, Incinerate and Deodorize.**
5. **Incinerate only.**
6. **Incinerate and Deodorize.**
7. **Flash Dry and Deodorize in conjunction with refuse and garbage incineration—plus incineration of sludge if desired.**

C-E Raymond Systems now in service or on order serve an equivalent population of more than 17,000,000 people – in communities ranging from 6,000 to 3,600,000 in population . . . in every section of the country, and even overseas.

Whatever your requirements – there is a C-E Raymond System that will satisfy them precisely. Let one of our engineers show you or your consultants how this leading system of sludge disposal will work for you. B-772A

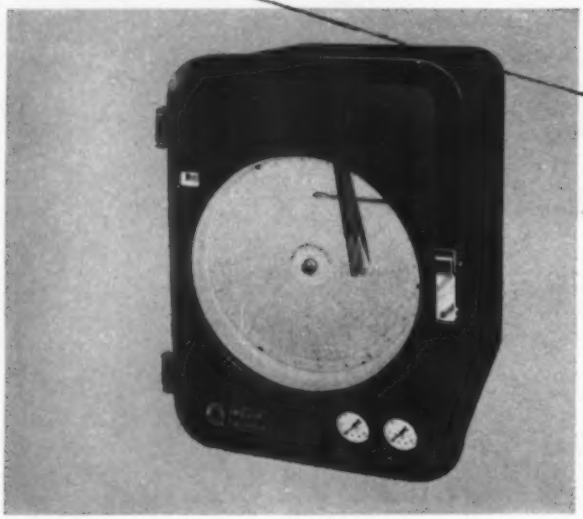
COMBUSTION ENGINEERING • Raymond Division

1315 North Branch Street, Chicago 22, Illinois • Eastern Office: 200 Madison Ave., New York 16, N. Y.
Western Office: 510 W. Sixth St., Los Angeles 14, Calif.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WATER DISPOSAL

HAGAN

Ring Balance Meter *beats the high cost of* Permanent Pressure Loss!



It works out like this:

Using an Expensive Primary Element . . . 10% of 100″ full scale differential is *10″ PPL*

Using a Low Cost Primary Element . . . 50% of 6″ full scale differential is *only 3″ PPL*

The Hagan Ring Balance Meter is particularly adapted for accurate operation at full scale differentials as low as 1″ WC, with *any* type of primary element. In many applications, by choosing a low cost, low differential element, with a PPL of 50% or more, and measuring the flow with a Ring Balance Meter, the actual permanent pressure loss is low. In the example shown above, *it is only a third of the actual PPL* sustained with a high cost, high differential primary element. Here is positive, long range economy . . . lower pumping costs result from reduced horsepower requirement.

This is an example of how Hagan experience and engineering skill can reduce costs. Hagan engineers will be glad to recommend the most economical solution to your metering problem.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems, Ring Balance Flow and Pressure Instruments . . . Metallurgical Furnace Control Systems . . . Control Systems for Automotive and Aeronautical Testing Facilities

Lake Fort Smith, the Clear Creek Water System's storage reservoir. Filter House is in lower left foreground.

ALOXITE® underdrains used for Fort Smith's Clear Creek Water System

The Clear Creek Water System, which supplies 75,000 people in and around Fort Smith, Arkansas, ranks among the most modern in the Southwest. Soft, sparkling clear Ozark Mountain water is piped from Lake Fort Smith to the City's distribution system through 23 miles of conduit. Put into service in 1936, the system has been expanded twice. The first addition was made in 1942; the second one has just been completed.

The filter plant, located just south of Lake Fort Smith's effluent, has a rated capacity of 12MGD. According to Jay Medlen, Fort Smith Public Works Commissioner, the ALOXITE® aluminum oxide porous underdrains used throughout the plant have proved most successful, providing trouble-free, economical service. Backwash is complete, without mud balls. Loss of head is held to a minimum. And since there is no need for graded gravel support, the problem of upset beds is eliminated.

Fort Smith deserves congratulations for its modern, efficient water system. Credit also must go to W. R. Holway and Associates, Designing Engineers, of Tulsa, Oklahoma, who designed and built the original plant and the latest additions; and to the S. E. Evans Construction Company, of Fort Smith, Arkansas, as principal contractor for the furnishing and placing of 70,000 feet of 36 inch prestressed reinforced concrete pipe, including a 3,000 foot tunnel under the Arkansas River at Van Buren, Arkansas; and to Foresgren Brothers, of Fort Smith, Arkansas, as principal contractors on additional clear wells and filter plant expansion.

Write us for this informative 56-page booklet on porous media for all fields of filtration and diffusion. It's yours for the asking.

CARBORUNDUM

Registered Trade Mark

Dept. M-104, Refractories Div. Perth Amboy, New Jersey

The test of a century

F.P.G.

This is Lancaster, Pa., County seat in one of the most highly cultivated farming districts in America.

Bettmann Archive

Old print showing southwest view of Lancaster about 100 years ago.

MODERNIZED cast iron

is the test that tells!

LANCASTER installed cast iron water mains 100 years ago . . . and installs them today.

Lancaster, Pa., has grown in 100 years from about 12,000 population to nearly 65,000 — but it has not outgrown the habit of buying cast iron pipe. From four miles of water mains a century ago, the present distribution system has increased to 105 miles of pipe—all of it cast iron pipe. Services have grown from 2,000 to nearly 20,000.

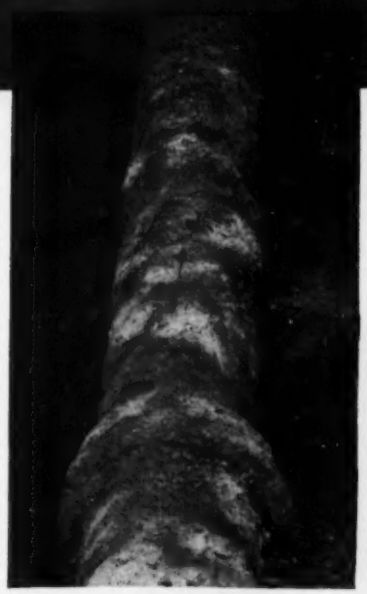
The word "test" means—"*put to the proof*"—according to the dictionary. Well, 60 utilities have put cast iron pipe to the *proof* for a century—a test to end all tests. They installed cast iron water or gas mains 100 years, or more, ago that are still in service. Yes, the test of a century has *proved* beyond question the long life and low cost per service year of cast iron pipe.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe. Managing Director, 122 So. Michigan Ave., Chicago 3.

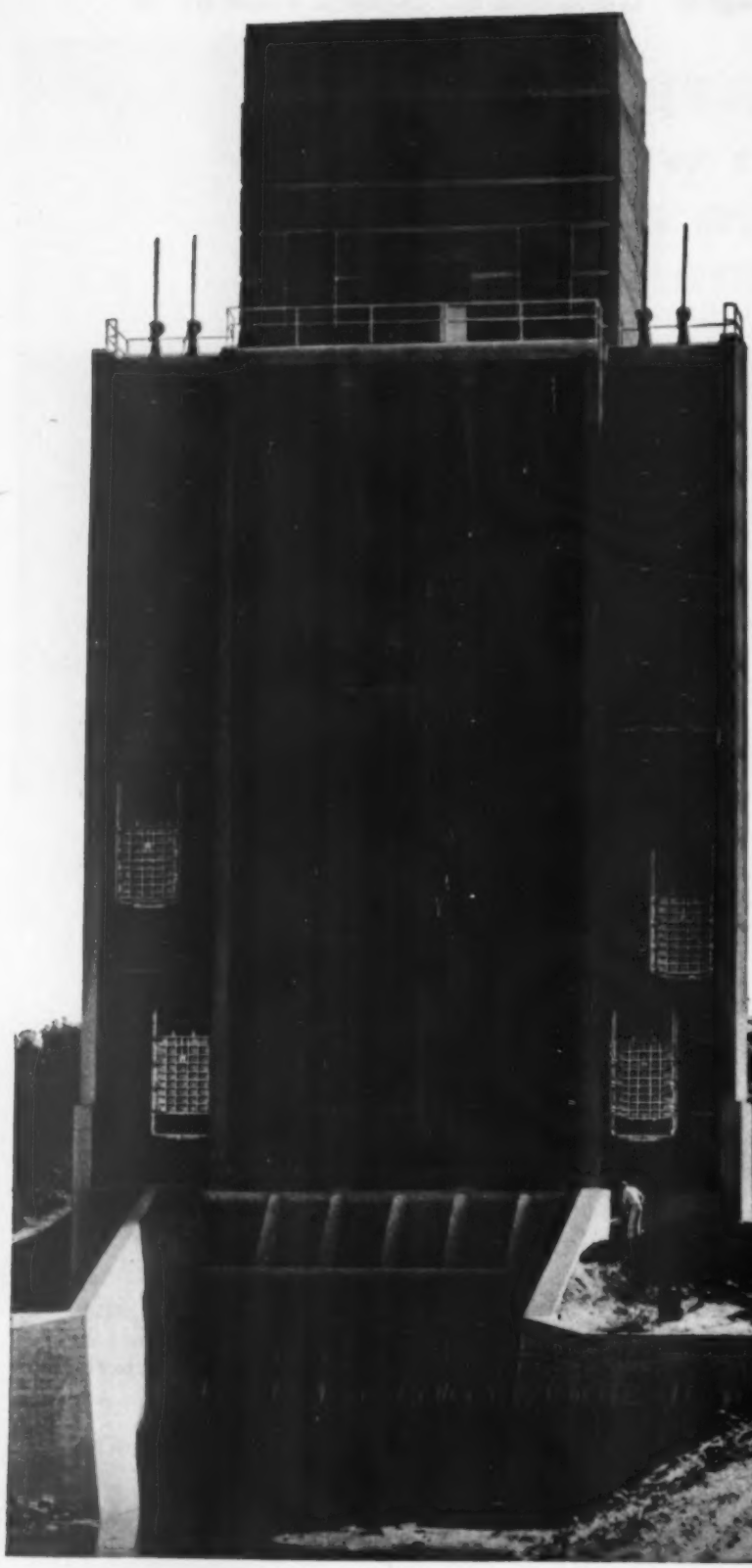
CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.



This cast iron water main laid in 1835 by the Bureau of Water of Lancaster is still functioning after 119 years of service.

pipe FOR MODERN WATER WORKS OPERATION



You are standing at the bottom of a lake!

The lake isn't made yet, but when it is filled it will be the Garza-Little Elm Reservoir on the Trinity River in Texas. The outlet-works for this great flood control and water storage project stands before you. It will protect the Trinity River Valley for 300 miles to its mouth in Galveston Bay.

Four 60- by 84-inch Rodney Hunt cast iron bronze-mounted sluice gates with Rodney Hunt hoists control the low-discharge flow of this huge outlet works rising 75 feet (not counting tower) above present ground level. The Rodney Hunt gates operate under heads of 25 to 48 feet.

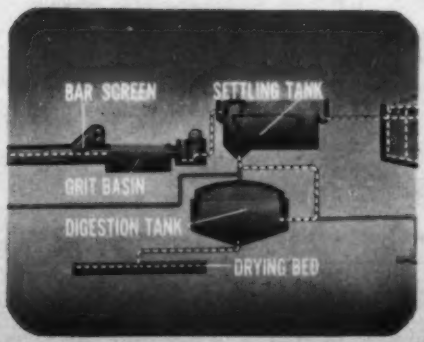
Specify Rodney Hunt for Sluice Gates and Hoists of superior quality . . . over 2000 combinations of standard types and sizes available . . . and send for our 232-page profusely illustrated catalog. A special 28-page section gives valuable hydraulic engineering data. Write on your letterhead for Catalog WCA 952.

RODNEY HUNT MACHINE CO.
Water Control Apparatus Division
84 Lake Street, Orange, Mass., U.S.A.

RODNEY HUNT®
Manufacturing Engineers Since 1840

Rodney Hunt agents in principal cities throughout the United States.

"CLEAN WATERS"



The 1954 edition of G.E.'s dramatic color movie to be premiered at October meeting of Federation of Sewage and Industrial Wastes Associations

General Electric's full color, sound motion picture, CLEAN WATERS, which forcefully illustrates the dangers of water pollution, has been completely refilmed and brought up-to-date. This public-service film points out the dangers to home, farm, and industry arising from polluted water sources, and outlines a permanent solution to the problem —modern waste treatment.

The original film—first shown seven years ago —was viewed by more than one million people throughout the world and was nationally acclaimed by community and industrial organizations who utilized it in launching campaigns to clean up their water sources.

This dramatic new edition of CLEAN WATERS can be an indispensable tool in helping you promote the increase of adequate sewage and waste treatment. It will be premiered at the annual meeting of the Federation of Sewage and Industrial Wastes Associations in Cincinnati, October 11-14. Be sure to see it. General Electric Co., Section 666-87A, Schenectady 5, N. Y.

More Power to America

GENERAL ELECTRIC

How much for maintenance?

In figuring the cost of a trash pump, what do you allow for maintenance . . . how much to clear out the trash that clogs the impeller? Will it be daily? Every other day? Weekly?

Or figure it this way. What price a pump that won't clog . . . that will virtually eliminate maintenance? That's why you should figure the Fairbanks-Morse Bladeless Impeller Pump! Its unique whirling tube won't clog . . . there are no blades or projections to catch and hold trash.

This is just one more example of the quality that is Fairbanks-Morse . . . in design, materials, workmanship, a standard of quality that gives you more for your pump dollar. For pump performance you can depend on, rely on the world's largest manufacturer of a complete pump line. See your Fairbanks-Morse Branch or write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

OUR INTEGRATED OPERATION PERMITS MAXIMUM CONTROL OF QUALITY

Ore and Coal Mines

Coke Ovens

Blast Furnaces

Pipe Plants

U.S. PIPE

From start to finish, our wholly integrated operation makes it possible for us to control quality at every step. Beginning with our mines, quarries and blast furnaces. Ending with our modern casting machines and laboratories.

Responsibility for quality rests squarely on the shoulders of a wholly integrated producer. He shares that responsibility with no one.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to our own quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

U. S. PIPE & FOUNDRY COMPANY

GENERAL OFFICES: BIRMINGHAM 2, ALABAMA

A wholly integrated producer . . . from mines and blast furnaces to finished pipe.

~~MILLS PLASTIC~~ BUTYRATE III does jobs metal pipe can't do. Often cuts installation costs 50% and more

Mills Plastic III pipe weighs only about 1/10 as much as metal pipe of the same diameter, yet it takes on the toughest jobs. It speeds installations amazingly because it can be cut with an ordinary hand saw, and can be quickly joined with Milex fittings and Mills Plastic III Solvent. (The simple technique is shown at right. Flange adapter unions are available to adapt from S.W.P. sizing to iron pipe thread where required. Ask your distributor for details, or write for new booklet describing all Continental Mills Plastic piping, tubing and fittings.

PETROLEUM — Here's the ideal pipe for refinery discharge, crude oil, sour crude, salt water and natural gas.

UTILITIES — Easily installed in corroded gas lines by push- or pull-through methods. Eliminates trenching and repaving.

INDUSTRY — Successful where corrosive liquids or mineral depositions damage other pipe. Smooth walls increase flow rate.

AGRICULTURE — Installing stock watering lines, sprinkler systems and irrigation lines becomes a one-man job with Mills Plastic III.

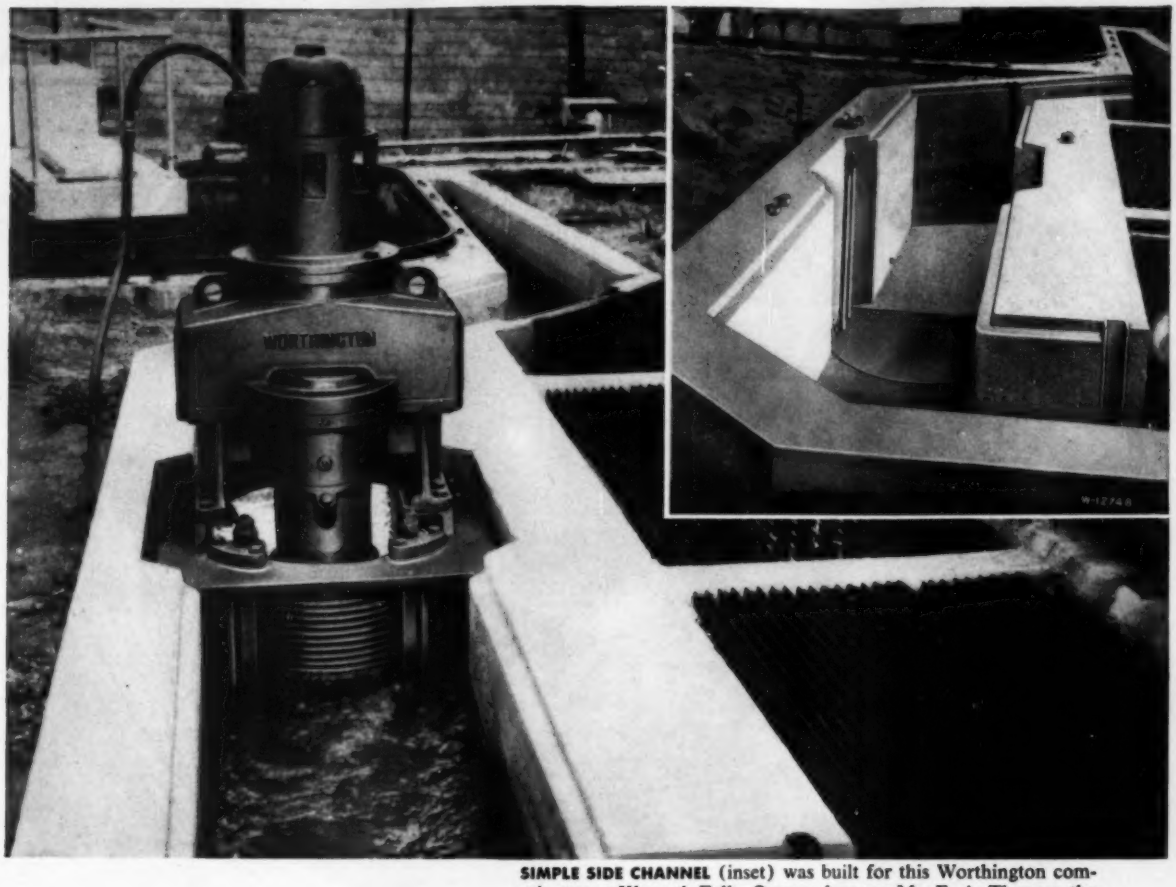
1. Wipe pipe end with Mills Plastic III Solvent.

2. Wipe inside of fitting with Mills Plastic III Thinner.

3. Insert the pipe end into the prepared slip fitting.

4. The job's done. Pipe can be handled in minutes!

CONTINENTAL CAN COMPANY
MILLS PLASTIC PIPE DIVISION
SALES OFFICE
100 EAST 42nd STREET, NEW YORK 17, NEW YORK
Factory: 2930 North Ashland Avenue, Chicago 13, Ill.



SIMPLE SIDE CHANNEL (inset) was built for this Worthington comminutor at Klamath Falls, Oregon, because Mr. E. A. Thomas, the City Engineer, wanted to use the existing channel as a by-pass.

Low installation cost swings Klamath Falls to Worthington

Since the Worthington comminutor is designed so that raw sewage flows straight through its screen, it's easily installed in a straight rectangular sewage channel.

Result? Expensive masonry work is not needed, which makes for simplified, low-cost installation.

This was an important factor in the selection of a Worthington 25C6 comminutor as part of recent improvements at the Klamath Falls, Oregon, Sewage Treatment Plant.

This comminutor, installed downstream from a grit chamber and upstream from a clarifier, was lifted directly from its packing crate and set right in the channel in a minimum of time.

Easy-to-remove cutter racks for occasional sharpening and the built-in flood protection provided by a mercury seal are other advantages of the Worthington comminutor.

Get all the facts and figures on the rugged Worthington comminutor. Check with your nearest Worthington district office. Or write today for new engineering manual on comminutors, W-317-B17. Worthington Corporation, Public Works Division, Harrison, N.J.

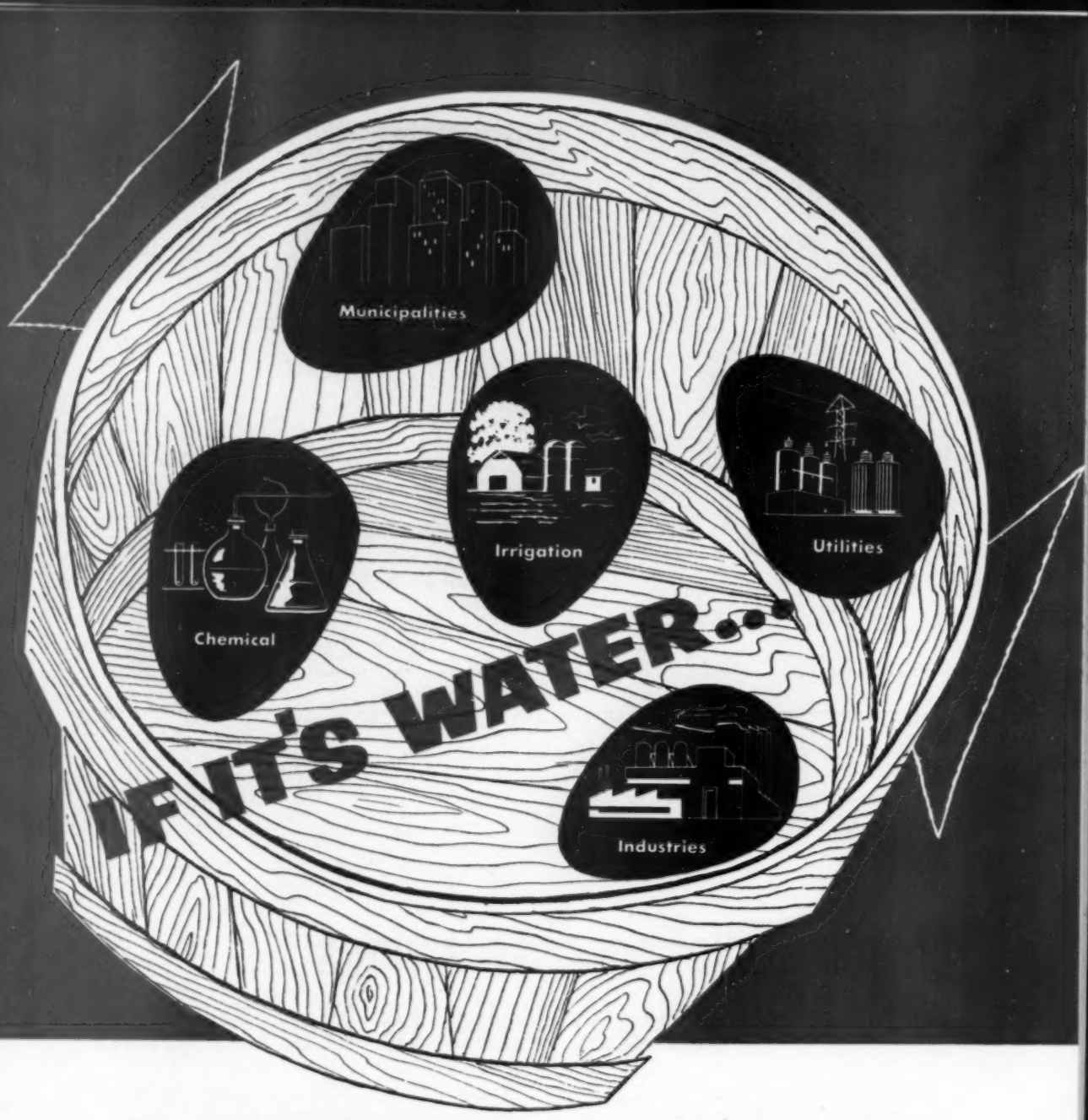
W.4.5

SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street.

WORTHINGTON

ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps



.... put all your eggs in one basket!

Whether it's water for municipality—industry—or farm, divided responsibility is dangerous. Put your eggs, all your eggs in one basket. Layne—the world's largest developer of ground water resources—offers a service that is truly unique. From preliminary exploration through well drilling to installation of equipment, you do business with one organization that assumes complete and undivided responsibility for the finished system. Wise men know that on any question that relates to water—it's good business sense to talk first to Layne.

LAYNE & BOWLER, INC.
Memphis 8, Tennessee

Layne

Layne Associate Companies Throughout the World

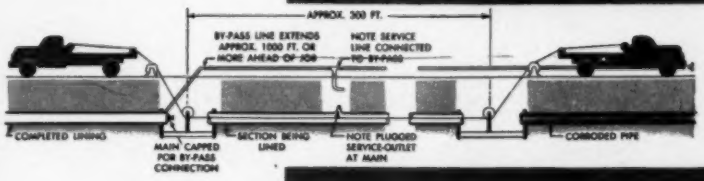
Water Wells • Vertical Turbine Pumps • Water Treatment

you seen an Eskimo pipe?

Practically the only materials available to the early Eskimo for his pipe were bone, ivory and small twigs. The most primitive type of pipe was made by splitting a straight willow wand, removing the pith and hollowing out one end for the bowl, then binding the two hollowed out pieces to form the long stem. Mighty tough smoking for the Eskimo who couldn't enjoy the straight, clean and easy-drawing pipes made today!

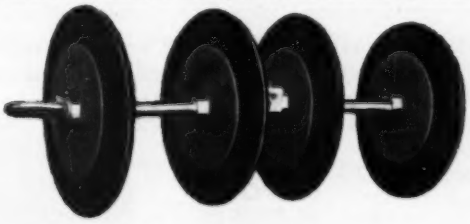
you seen a modern pip[illegible] lining operation?

The Tate Process, applicable to water, oil and gas pipe lines, renews old iron and steel pipe "in place" as shown here in the schematic drawing. The Tate Process is applicable to pipe lines from 4" to 16" in diameter. Only momentary interruption to service is necessary while by-pass sections are installed.

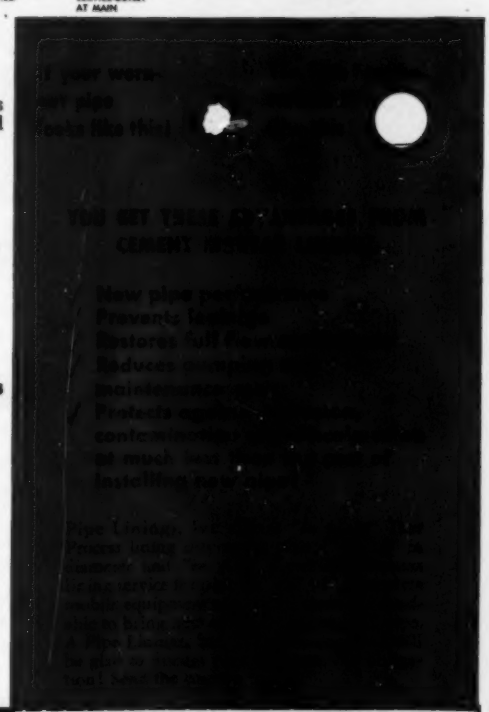

APPROX. 300 FT.
BY-PASS LINE EXTENDS APPROX. 1000 FT. OR MORE AHEAD OF JOB
NOTE SERVICE LINE CONNECTED TO BY-PASS
COMPLETED LINING
MAIN CAPPED FOR BY-PASS CONNECTION
SECTION BEING LINED
NOTE PLUGGED SERVICE-OUTLET AT MAIN
CORRODED PIPE

you seen the *Steel Scraper?*... It is pulled through pipe, dislodges all incrustation, corrosion and tubercles, makes inside clean and smooth.

you seen the *Rubber Swabber?*... It follows the scraper and pulls out loosened material leaving pipe clear and free of debris.



you seen the *Tate Process liner?*...It completes the renewing process by squeezing cement mortar onto the inside of the pipe wall, making the surface smooth and water-proof. Liquids move swiftly without drag.



2414 East 223rd St., Wilmington, California
Rail Address: Watson, California

PIPE LININGS, Inc., P. O. Box 457, Wilmington, California

( ) Please send complete information on how to obtain new pipe line performance from my old pipe.

( ) Please have one of your hydraulic engineers call on me.

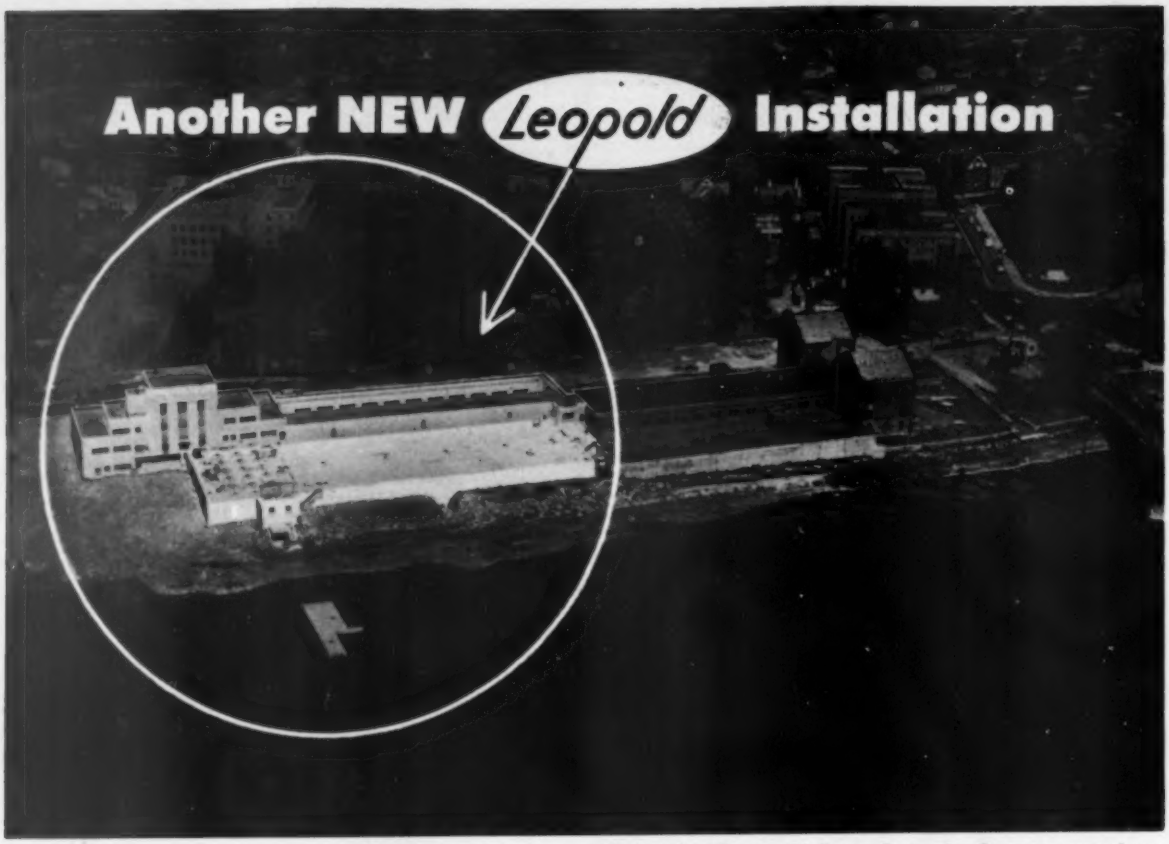
Name_____

Title_____

Company_____

Address_____

City_____ State_____



Aerial view of new water purification plant, Trenton, N.J. Eastern Engineering Company—general contractors. Bowe, Albertson & Associates—consulting engineers. Lewis W. Klockner, Jr., is superintendent-engineer of the Trenton Water Department, which is under the jurisdiction of Mayor Donal J. Connolly.

Trenton, N.J. Water Filtration Plant Chooses **LEOPOLD** Filter Bottoms

To better serve its 180,000 customers, the City of Trenton has recently completed a new water filtration plant. These modern facilities, built at a cost of approximately $3,500,000, can treat 25,000,000 gallons per day. Head house is designed to ultimately accommodate a duplication of the sedimentation, flocculation and filter operations.

For this up-to-date installation, it's not surprising that Leopold Glazed Fire Clay Tile Filter Bottoms were selected. Today, they're successfully serving over 250 plants with a daily capacity of more than 1¼ billion gallons. If you're looking for an economical solution to your underdrain problems, consider all the advantages offered by Leopold. We'll be glad to supply details, without obligation.

LEOPOLD FEATURES

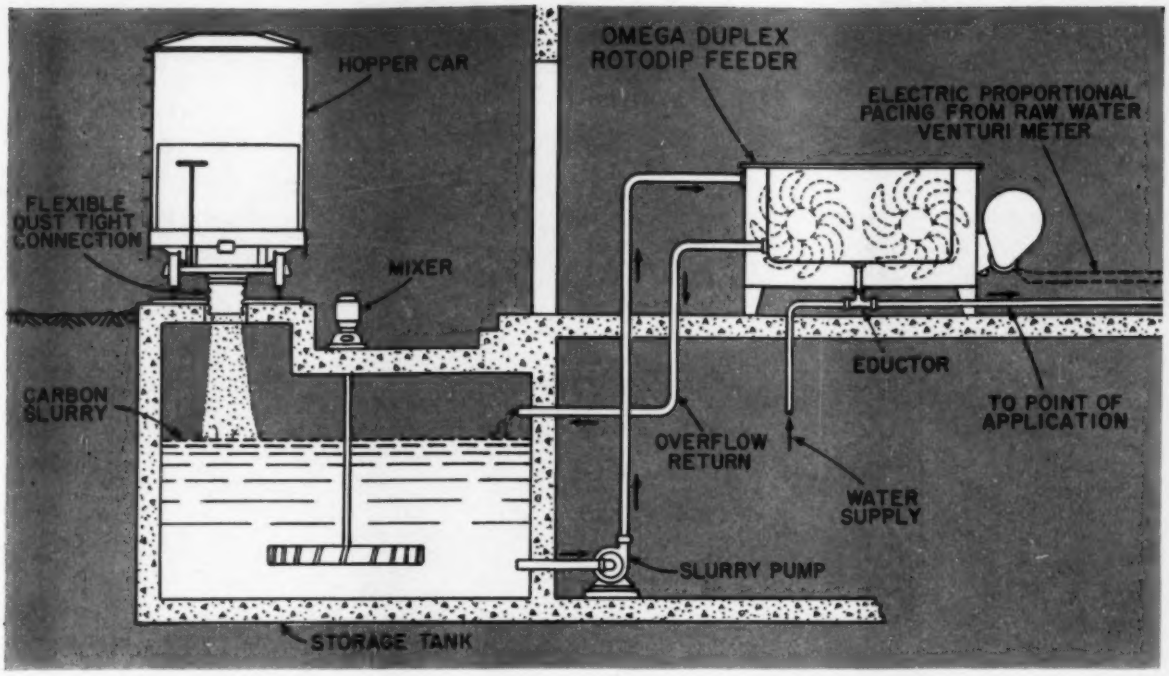
No possible corrosion or tuberculation anywhere in filter bottom • De-aired fire clay blocks are practically non-absorbent • Equal filtration; also equal distribution of wash water over entire bed • Requires only shallow depth of small-sized filter gravel • Long life, efficient performance

Leopold

F. B. LEOPOLD CO., INC.

2413 W. CARSON STREET, PITTSBURGH 4, PA.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT • DRY CHEMICAL FEEDERS
FILTER OPERATING TABLES • MIXING EQUIPMENT

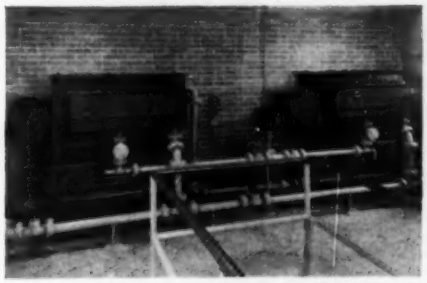


Houston shows how to cut carbon handling costs

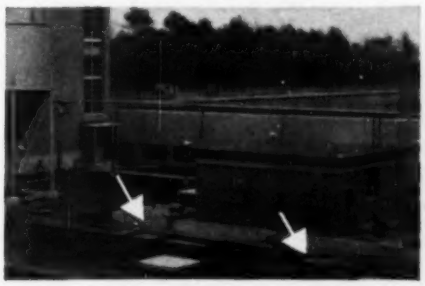
Activated carbon for controlling the taste and odor of Houston's water supply is received in carload lots at the Houston Water Purification Plant. As shown in the diagram, the carbon is then fed in slurry form by Omega Rotodip Feeders, the super-accurate solution feeders which are specially designed for this type of service. Here are the advantages of this modern chemical feeding system:

1. **Reduced handling costs** — carbon is dumped directly into storage tanks and then handled in an enclosed system to point of application.
2. **Reduced construction costs**—system permits below-ground storage.
3. **Great flexibility** — wide feeding ranges and large dosages are easily obtained.
4. **Simpler housekeeping** — system totally eliminates carbon dust.
5. **Greater safety** — fire hazards virtually eliminated.

Carbon slurry feeding is another example of how "The Last Word in Feeders" save money in the feeding of chemicals. For further information on this and other advanced types of dry and liquid chemical feeders, write Omega Machine Company, 350 Harris Ave., Providence 1, Rhode Island.



Omega Duplex Rotodip Feeders for feeding and metering carbon slurry at Houston Water Purification Plant. This plant also employs Omega Gravimetric Feeders for alum, ferrifloc, quicklime, and soda ash.



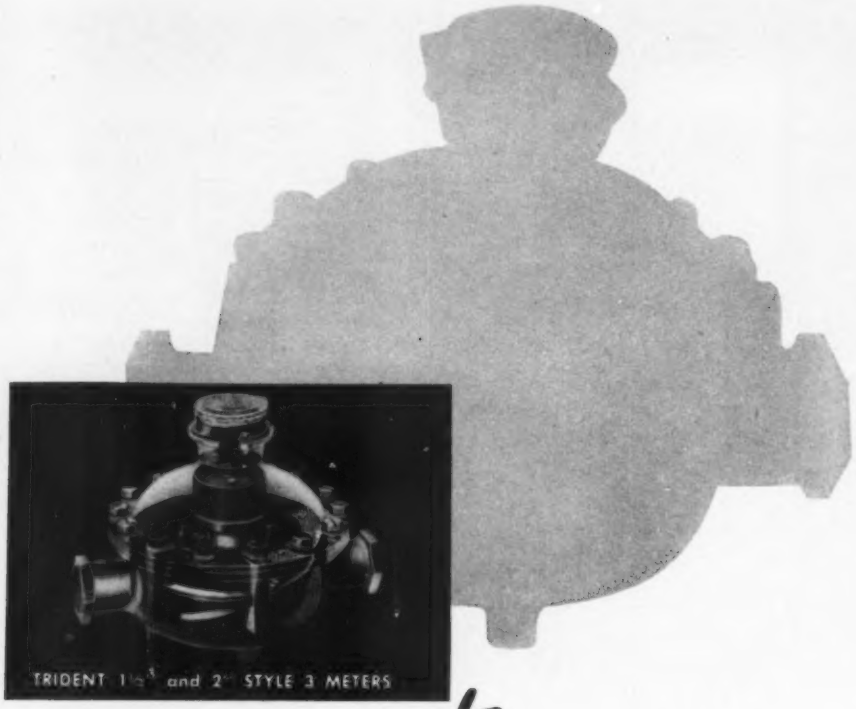
Chemical Building which houses Omega Rotodip Feeders. Arrows point to railroad siding and storage tank covers. Plant engineering was by Freese, Nichols & Turner — of Houston, Texas . . . installation by E. W. Bacharach, Inc., Kansas City, Mo.

OMEGA *THE LAST WORD IN* FEEDERS

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • BUILDERS-PROVIDENCE, INC.

BIF METERS FEEDERS CONTROLS



LARGE METER *Capacity* + SMALL METER *Sensitivity* = MAXIMUM *Revenue*

No proud father would argue that twins are as easy to take care of as one. That's one reason Neptune Trident Style 3 meters are recommended in place of compound meters for 1½" and 2" service lines. The Style 3 disc meter is accurate down to exceptionally low flows, and handles high flows with ease.

The simpler Style 3 meter maintains accuracy longer, and repairs (when necessary) are easier. Modern Style 3 parts fit older meters. There's no obsolescence . . . you modernize as you go. And its lower initial cost gives you a nice saving. So why use two meters when one will do the job?

Style 3 meters were the first to feature a special pressure adjustment. In high-pressure lines, the outlet of the meter is throttled to prevent overspeeding, and in low pressure installations, the outlet is opened wide to minimize loss of head.

Proof of the accuracy and efficiency of the Trident Style 3 will be found in your own testing equipment . . . in lower maintenance costs . . . and in increased revenue.

NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities

neptune

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WATER & SEWAGE WORKS

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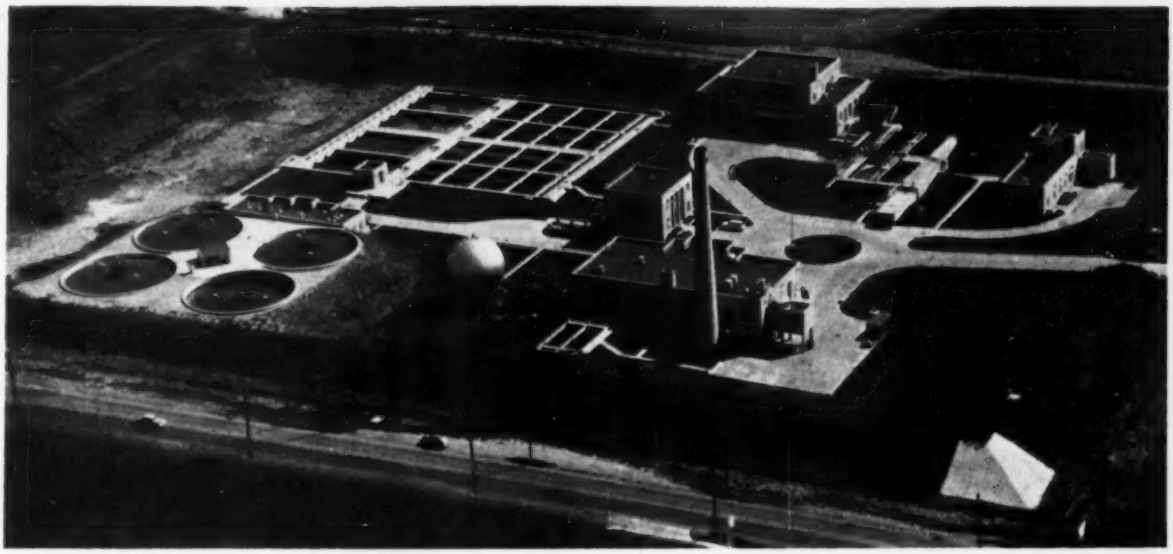


LITTLE MIAMI Sewage Treatment plant. The first of four for Cincinnati.

Cincinnati's New Sewage Plant

The Little Miami Sewage Treatment Works, first of four, cost $6 million and has capacity for 29 mgd

by DAVID BACKMEYER

THE FIRST sewage treatment plant to serve the Metropolitan Cincinnati area was officially dedicated and placed in operation on October 6, 1953. This plant, known as the Little Miami Sewage Treatment Works, was in the final stages of construction at that time, and actual plant operation on a continuous basis was not possible until several months later.

The treatment plant, built at a cost of approximately 6 million dollars, is located on a 10-acre tract of land in the flood area in the eastern part of the City. The plant is surrounded by an earth dike affording flood water protection to an Ohio River stage of 72 feet.

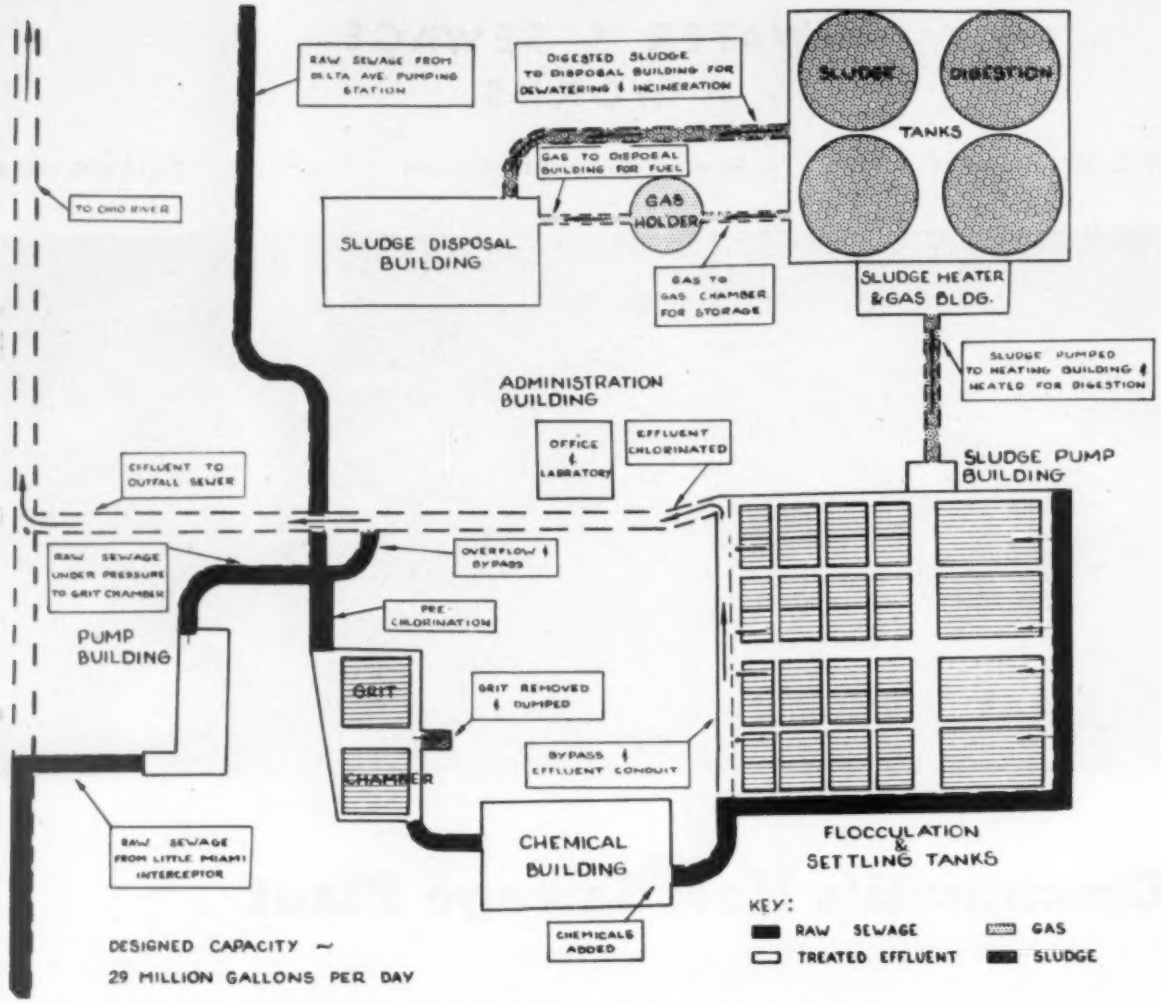
Four Purposes of Treatment

The treatment plant is the first of four scheduled for Cincinnati. The Little Miami works were designed and built to meet a fourfold purpose incorporating the following principles: (a) protection of water supply, both local and downstream; (b) elimination of physical nuisance in the receiving stream; (c) restoration of recreational functions as related to stream sanitation; and (d) compliance with restrictions imposed by law or agreement.

Mr. Backmeyer is Superintendent of Cincinnati's Little Miami Sewage Treatment Works. His previous service with the city of Marion, Indiana, covered a period of twelve years: four years as Superintendent of the Water and Sanitation Department, and eight years as Superintendent of the Sewage Treatment Plant. Prior to that, he was Chemist of the Richmond, Indiana Sewage Treament Plant.

To conform to "Treatment Standard No. 1" of the Ohio River Valley Sanitation Commission, enacted April 6, 1949, the Little Miami Sewage Works should accomplish the following:

1. Substantially complete removal of settleable solids.
2. Removal of not less than forty-five percent of the total suspended solids.
3. Reduction by not less than 65



SCHEMATIC flow diagram illustrating units in the Little Miami Plant.

per cent of the biochemical oxygen demand of organic wastes, provided, however, that whenever conditions permit, such lesser degree of reduction of biochemical oxygen demand, but not lower than 35 per cent, may be applied to organic wastes if as a result there will be no impairment in the Cincinnati Pool of a water quality standard of 4.0 parts per million of dissolved oxygen at the bottom of the oxygen sag in the Ohio River below Cincinnati.

The treatment works have been planned primarily for sedimentation, with provisions to enable variations in the degree of treatment as needed to meet the requirements set out above. This may be done with or without the use of chemicals.

The present design further contemplates chlorination of influent and effluent, when necessary, and includes facilities for elutriation, filtration, and incineration of digested sewage sludge solids. Effluent from the plant is diffused into the Ohio River through a submerged outfall sewer.

Treatment Plant Described

Specifically, the treatment works consists of:

Sewage pumps served from the Little Miami Interceptor, protected by bar grates and housed in a pump building.

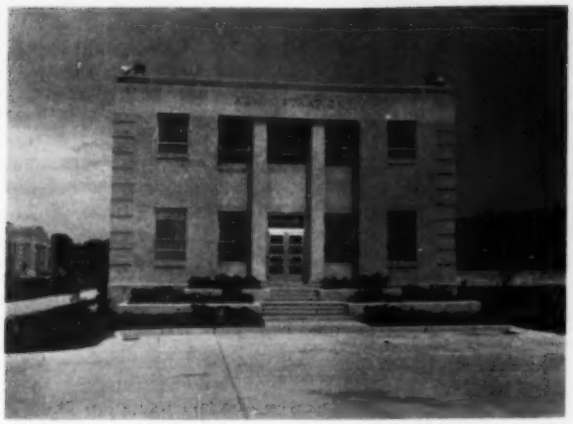
Grit removal tanks equipped for the mechanical removal, washing and elevation of the grit to trucks for transport to fill areas (within or outside the plant area).

Screenings Comminutors, chemical handling and dosing equipment, Venturi meter, chlorinators and blowers, all located in a chemical building

TABLE I

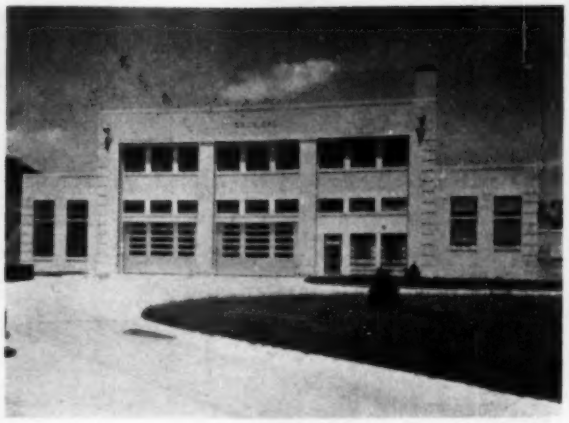
Characteristics of sewage treated at Little Miami plant

Month 1954	Flow mgd	Raw Sewage Tot. Sol.	Sus. Sol.	B.O.D.	pH	Grit C.F./M.G.	Screenings Wet Lb./M.G.
Jan.	10.34	944	281	185	7.4	2.97	213
Feb.	10.70	877	310	259	7.3	3.11	219
Mar.	13.03	861	378	258	7.3	2.72	176
Apr.	13.56	809	331	227	7.4	4.18	154
May	11.46	1132	609	360	7.3	3.89	149
June	14.35	766	272	119	7.5	0.78	116
Average	12.24	898	364	235		2.94	171



ADMINISTRATION building

Houses plant office (first floor) and laboratory (second floor).



CHEMICAL building

Chlorinators and chemical feeders, comminutors and shop are here.

which, also, will provide storage for chemicals, machine shop facilities and plant truck garage space.

Aerated channel leading from the chemical building to the flocculation-settling tanks.

Flocculation-settling tanks equipped with paddle wheels for flocculation, and with sludge removal mechanism in both the flocculation and the settling areas, and having sludge pumps located in an adjoining chamber.

Sludge digestion tanks providing exterior heating of the fresh and/or recirculated sludge, and including gas collection equipment connected to a gas holder and gas building which will house gas boosters and controls.

Sludge disposal facilities inclusive of elutriation tanks for sludge and supernatant, and vacuum filters and sludge incinerators grouped in or adjoining a sludge disposal building which also will house grounds drainage pumps.

Future expansion for secondary treatment facilities should they become necessary.

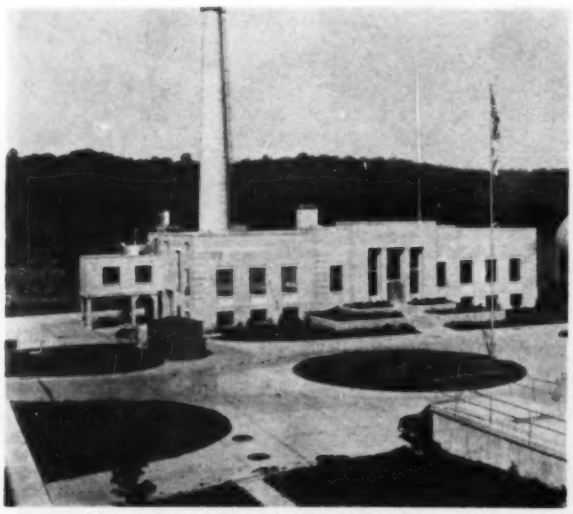
Enclosure and protection of the project area with flood protection dikes.

An administration building with laboratories, administrative office, and service accommodations.

Present Sewage Loadings

The Little Miami Valley area served by the plant is approximately 27 square miles. It incorporates a population of about 120,000 persons. Gaugings of the tributory sewage prior to plant construction indicated a flow of 18.0 mgd, with suspended solids of 270 ppm, and B.O.D. of 250 ppm. The plant design is based on a sewage of this strength and contemplates a future 1980 dry weather flow of 29.0 mgd. A second and much larger plant, with design capacity of 120 mgd to serve the highly industrialized Mill Creek Area, is now under construction and should be completed in 1958.

Although operational data available to date may not be too reliable, it is probably indicative in some respects of the present plant loadings.

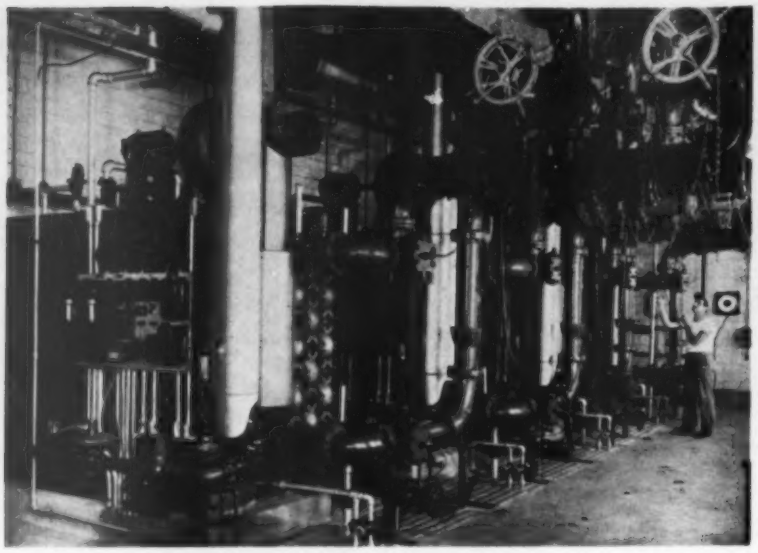


SLUDGE disposal building

Vacuum filters and sludge incinerators are in this building.

GAS storage sphere

Administration building and one of two grit chambers.



SLUDGE HEATING units and control equipment

The figures given in Table 1, covering the first six months of 1954, will serve to show the type of sewage presently being treated at the Little Miami Plant.

Some reservations should be made for those inconsistencies, as they always result from placing a new plant in operation. It was during the period noted above that a great many of the "new plant bugs" were eliminated or solved. In reviewing briefly the first eight months of operation, several significant factors may be worthy of mention.

In October of 1953, when the first raw sewage was pumped to the grit chambers and primary settling tanks, the general contractor's crew was busily engaged in completing work normally associated with a construction job of this magnitude. As a result, operational procedures were altered and adjusted to conform to the requirements of the construction work. This was particularly true during the first three months of operation—October, November and December of 1953. Throughout this breaking-in period much of the testing and adjusting of the mechanical and electrical equipment was completed.

Personnel Training Plan

With the exception of two administrative personnel, the staff employed to operate the plant had no experience in the operation of a sewage treatment plant. Many of the plant positions, particularly those related directly to operation, were filled through the City Civil Service prior to starting the plant. This arrangement enabled supervisory personnel to conduct training courses and in-the-field instruction classes to better acquaint the men with the basic functions of the various treatment units.

A comprehensive instruction manual was prepared as an aid in the schooling work. Periodic written examinations were given both to emphasize the shortcomings of those engaged in the teaching program, and at the same time to provide a competitive incentive for better work on the part of the students.

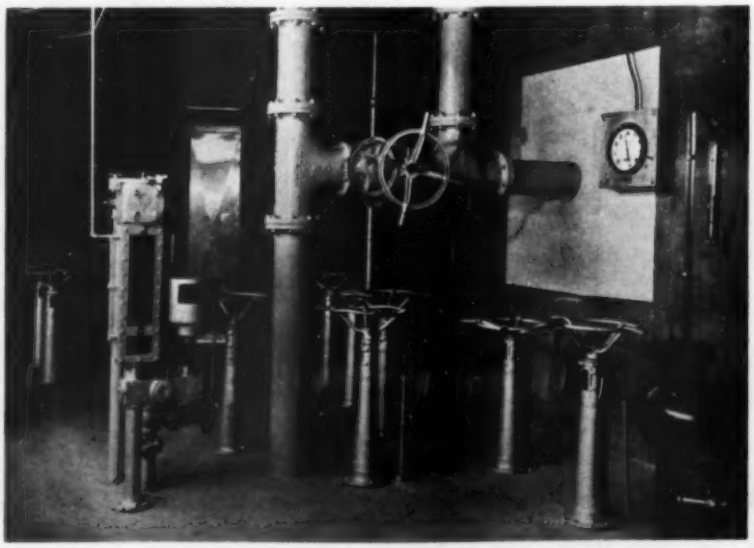
Without minimizing the value and importance of the technical information available from short course schools and text books, our experience would indicate the best way to teach sewage treatment plant operation to new personnel is by having them actually perform the necessary routine duties as the plant is first placed in operation. Although this system might seem to be somewhat costly at times, serious mistakes can usually be avoided by proper supervision, and the lessons thus learned by the new individual are not soon forgotten.

Problems of Operation

The development of normal operation in the sludge digestion system at Little Miami was accomplished with much difficulty. Although two of the four sludge digesters were immediately brought up to a temperature of 90°F by burning fuel oil in the Pacific Flush Tank sludge heaters, first-stage acid digestion produced a high concentration of volatile acids in both primary digestion tanks, and fermentation of sludge solids came to an abrupt halt. The gas produced during the acid stage contained 80 per cent carbon dioxide. The final solution to this interesting yet rather involved problem is a long story.

Proper digestion was established approximately nine months after the digesters were first placed in operation, and after several hundred volatile acid tests were made. One of the tanks was "seeded" with digested sludge from a nearby plant, once the first attempt at starting without "seed" was written off as a complete failure.

Five raw sewage pumps are located in the main pumping station at the plant. Each pump delivers 15.0 mgd,

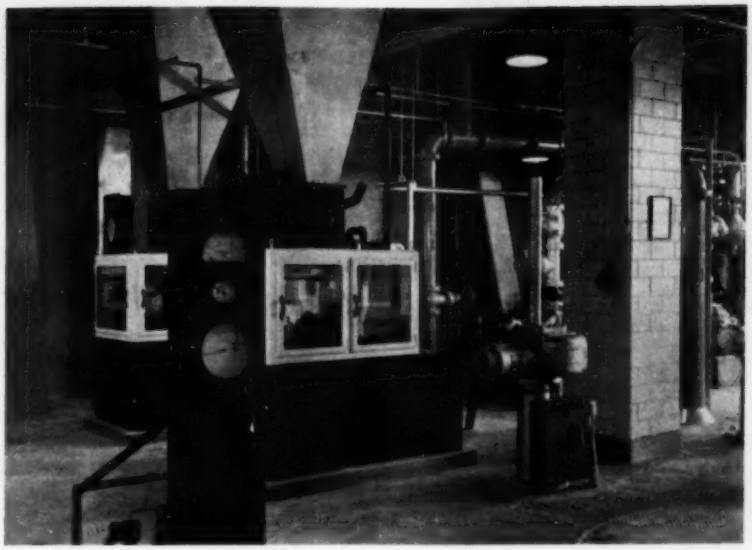


CONTROL equipment for one of four digesters

accounting for a total capacity for storm water pumpage of 75 mgd. With the present dry weather flow of about 14.0 mgd, intermittent pumping occurs for several hours during the night. This condition has created a serious problem of sewage sampling which is currently under study, but is yet to be resolved in a satisfactory manner. Sewage samples are collected at hourly intervals, and the analytical work in the laboratory is done on composite samples.

During the first seven months of plant operation excessive amounts of extremely fine sand passed through the grit basins and formed banks in the aerated feed channel discharging to the primary settling basins. These accumulations eventually covered the precision aeration tubes, and resulted in a complete plant shut down while the feed channel was drained and cleaned. The source of this waste (thought to be foundry core sand) is being investigated by the Industrial Waste Division of the Sewage Disposal Section. Appropriate action to stop the discharge of such material to the sewers will be taken in accordance with the regulations of the Industrial Waste Ordinance.

The vacuum filters and related equipment provided for the dewatering of digested sludge, and for subsequent burning of sludge cake in the incinerators has been tested in a rather limited manner. When sufficient digested sludge becomes available (probably October and November this year), more comprehensive operations will be carried out with the sludge disposal system. Present plans call for complete burning of the sludge filter cake. The ash is to be disposed of in a low area on the plant site.



FLOW METER and two gravimetric alum feeders

Thirty-two persons are currently employed at the Little Miami Works. Their classifications are as follows: superintendent, assistant superintendent, sewage plant chemist, senior stenographer, junior laboratory technician, cleaner, maintenance foreman, maintenance machinist, electric instrument man, three firemen, two laborers, truck driver, thirteen sewage plant operators and four operation foremen.

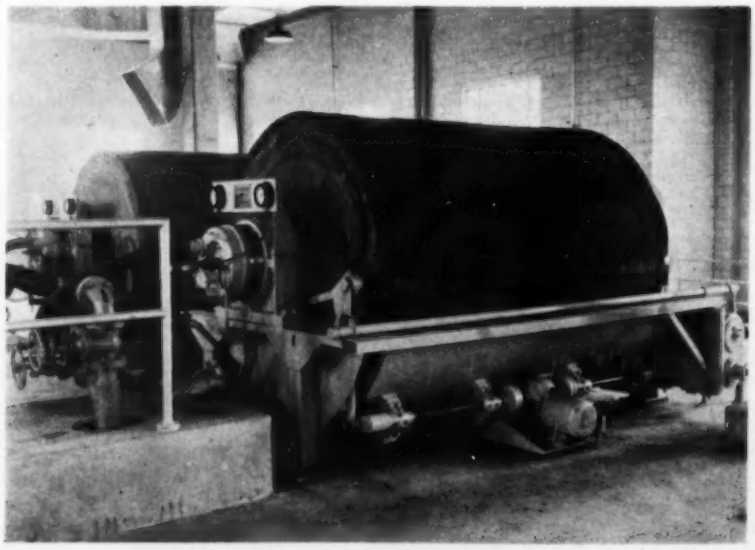
Plant Contractors

The principal contractor for the treatment plant was the James McHugh Construction Company, Inc., of Chicago, Illinois, who performed the work required under Contract No. 3. In addition to this work, the scope of the project incorporated several other important contracts.

Contract No. 1 with General American Transportation Company covered the furnishing of the four Conkey Vacuum filters and appurtenant equipment items. Installation of this equipment was done by McHugh Construction Company, Inc.

The two-multi-hearth incinerators were furnished and installed by Nichols Engineering and Research Corporation under Contract No. 2. Both of these latter contracts were let approximately one year prior to the time Contract No. 3 was signed.

The furnishing and installing of laboratory furniture and equipment under Contract No. 4, was awarded to Kewaunee Manufacturing Company of Adrian, Michigan.



VACUUM filters, two of the four units

Unusual Features Provided

Several interesting and unique construction features incorporated in the Little Miami plant are deserving of special mention. Process water to be used in the plant for the elutriation of digested sludge, the feeding chlorine to the sewage, and as seal water for the pumps, is furnished from two ground water wells, each about 80 ft. deep, and with aggregate capacity of 500 gallons per minute.

The roofs of two of the buildings are constructed to serve as emergency storage space for electric motors and related equipment, should extreme high water conditions necessitate the

MULTI-HEARTH incinerators to burn dewatered sludge

flooding of the plant proper. Although the frequency of a flood that would top the dike is once in eighty years, special hatches, cranes, and hoists have been provided for emergency use.

The buildings and structures located inside the dike-enclosed area are built on piling designed to give bearing stability and uplift protection against ground water and flood conditions. A total of 75,000 lineal feet of concrete piling was placed for this purpose. The buildings are of stone trim, in keeping with the architectural style of other Cincinnati municipal buildings. Aluminum windows and doors have been used throughout, and tile walls have been utilized extensively in the superstructure. Shower, locker and toilet rooms are provided in each of the five principal buildings.

Landscaping of the grounds, a part of Contract No. 3, included the plant-

Equipment Inventory—Cincinnati's Little Miami Sewage Treatment Plant

1—Elevator with a carrying capacity of 2000 lb. at speed of 100 ft. per minute by Westinghouse Electric Corp.

3—333 K.V.A., 13.2 KV/480V transformers by Westinghouse Electric Corp.

1—7½ ton capacity double girder crane by Abell-Howe Co.

2—Detritors, 40'x40', equipped with revolving scrapers and reciprocating rake by Dorr Co.

3—Comminutors, 30 M.G.D. each by Chicago Pump Co.

2—Alum Feeders, Dry Feed machines of 10 to 1000 lb. per hr. each by Omega Machine Co.

3—Solution feed vacuum chlorinators—4000 lb. per 24 hrs. capacity each by Wallace & Tiernan Co., Inc.

2—Chlorine Evaporators, electrically heated, capacity each 6,000 lb. per 24 hrs. by Wallace & Tiernan Co., Inc.

1—Platform scale 8'x6', capacity of 6 tons by Howe Scale Company.

1—Venturi-meter, 66"x33", range 8 to 90 M.G.D. by Builders Providence, Inc.

2—Rotary blowers, 600 C.F.M. each, against 4 lb. pressure by Roots-Connersville Blower Corp.

154—Air diffuser tubes by Chicago Pump Co.

12—Flocculation units, paddle type, in 4 tanks 41'x61'x14.75' deep, by Link-Belt Co.

8—Straight line sludge collectors operating beneath flocculators by Link-Belt Co.

8—Straight line sludge and scum collectors, operating in 4 primary settling tanks 40'x 124'x12.5' deep, by Link-Belt Co.

2—Straight line sludge collectors, operating in two 12'x45'x12' deep elutriation tanks, by Link-Belt Co.

4—Sludge heaters, 750,000 b.t.u. per hour each by Pacific Flush Tank Co.

4—Digestion tanks—65' dia. 26' sidewall depth with floating covers by Pacific Flush Tank Co.

1—Gas holder, 36' dia., providing storage for 49,000 cu. ft. at 29.9 p.s.i. by Chicago Bridge & Iron Company.

1—Ferric Chloride Storage tank, 108" dia. and shell length of 24 ft., 12,000 gal. capacity by American Boiler & Tank Co.

4—Conkey vacuum filters, 6' dia. x 8' (150 sq. ft. surface) by General American Transportation Corp.

3—Vacuum Pumps, ea. 600 c.f.m. by Worthington Pump & Machinery Co.

3—Filtrate Pumps ea. 70 g.p.m. by Worthington Pump & Machinery Co.

3—Rotary positive displacement blowers ea. 60 c.f.m. at 2 lb. pressure by Roots-Connersville Blower Corp.

1—Bucket elevator, 500-3000 G.P.H. by Sy-Co Corp.

42—Lineal ft. of 48" and 87 lineal ft. of 30" sludge belt conveyor by Link-Belt Co.

1—Sludge weighing mechanism of 5 ton per hour capacity by Builders Providence, Inc.

2—Multihearth incinerators 14'-3" diameter, 5 hearths, each 45 tons dry solids (60% combustible) daily capacity, with appurtenances by Nichols Engineering & Research Corp.

1—Ash spiral conveyor, elevator, and storage bin by Jeffrey Mfg. Co.

1—Ash conditioner, capacity of 25 tons per hr. of dry ash by United Conveyor.

23—Sluice Gates, varying from 8" to 60" x 60" by Chapman Valve Mfg. Co.

39—Check valves, varying from 1" to 16" by Chapman Valve Mfg. Co.

143—Lubricated Plug Valves, varying from 1" to 10" by Merco Nordstrom Co.

347—Gate Valves varying from 1" to 36" by Kennedy Valve Co.

5—Monorail Systems, 3-10,000 lb. capacity and 2-4000 lb. capacity by E. W. Buschman Co.

2—Deep well pumps, 250 g.p.m. at 90 ft. head by A. O. Smith Corp.

2—Bucket elevators, 667-4000 G.P.H. and 833-5000 G.P.H. by Jeffrey Mfg. Co.

3—Peerless automatic gas boilers, steam space heating by Eastern Foundry Co.

2—Combination boilers by Weil-McLain and fired by gas and oil burners by S. T. Johnson Co.

2—Boilers by Weil-McLain and fired by oil burners by S. T. Johnson Co.

13—Motor driven forced ventilation fans and exhausters by American Blower Corp.

1—Industrial vacuum cleaning system by Spencer Turbine Co.

1—Raw water pneumatic tank, 72" dia. and 16' long, by Old Dominion Iron & Steel Corp.

3—Gas Boosters capacity 140 cu. ft. per minute by Buffalo Forge Co.

2—Gas compressors, capacity 40 C.F.M. at 29.9 p.s.i. by Nash Engineering Co.

4—Gas Meters, Emco No. 5 by Pittsburgh Equitable Meter Co.

2—Gas Meters, Emco No. 4 ½, capacity 5000 cu. ft. per hr. by Pittsburgh Equitable Meter Co.

1—Gas Meter, Emco No. 1, capacity 400 cu. ft. per hr. by Pittsburgh Equitable Meter Co.

1—Gas Rotary Meter, capacity of 15,000 cu. ft. per hr. by Roots-Connersville Blower Co.

5—Angle Flow Pumps, 10,100 g.p.m. capacity each by Fairbanks-Morse & Co.

6—Sump drainage and supernatant pumps, capacities 2-100, and 4-200 g.p.m. by Nash Engineering Co.

2—Primary sludge scru-peller pumps, ea. 150 g.p.m. by Chicago Pump Co.

3—Ground drainage pumps, 1500, 3000, and 4500 g.p.m. by Fairbanks-Morse Co.

2—Sludge Circulation trash pumps, capacities each 400 g.p.m. by Fairbanks-Morse & Co.

2—Sludge trash pumps, capacity 500 and 1500 g.p.m. by Fairbanks-Morse & Co.

2—Water Supply and Elutriation split-casing pumps, capacity 250 g.p.m. and 420 g.p.m. by Fairbanks-Morse & Co.

Laboratory furniture, benches and cabinets, by Kewaunee Manufacturing Co.

ing of 23 trees, 405 shrubs, 714 vines, and all the required seeding and sodding. In addition 27,640 Hall's Japanese Honeysuckles were planted on the slopes of the earth dike to provide a dense cover and give protection against erosion. Land area for future expansion of treatment facilities is available at the North end of the present plant grounds.

Sewage Pumping Equipment

Approximately 15 per cent of the sewage to be treated at the Little Miami Plant will be pumped from a separate pumping station on Kellogg Avenue, south of Delta Avenue. The intercepted dry weather flow from the Delta Avenue combined storm-sanitary sewer is screened by Comminutors and pumped by one or a combination of three raw sewage pumps, each rated at 3.0 mgd capacity. A regulator chamber will control the flow to the pump wet well during storm water run-off periods.

The pump building, a five-story structure with circular lower section 30 ft. in diameter, is 67 ft. high, and is located so that only the top story is above grade and visible from the street. The force main, a 24-in. cast iron line, connecting the Delta Avenue Pumping Station to the Little Miami treatment plant was built by W.P.A. in 1940.

Most of the sewage entering the treatment plant flows through the Little Miami interceptor. This sewer has a diameter of 6 feet, and was built in 1939. In November 1952, the Penker Construction Co. was awarded a contract to build the Delta Avenue Pumping Station and the Duck Creek Regulator. The latter structure provides a physical connection between the old existing Duck Creek interceptor and the new Little Miami interceptor, as well as storm water diversion to the Little Miami River.

The engineering and supervision for construction of the Little Miami treatment plant was handled cooperatively by the consulting engineering firm of Havens and Emerson, Cleveland, Ohio, and the City of Cincinnati. City engineer T. J. Montgomery and principal construction engineer Charles C. Bolton, were in charge of supervision for the City. Final approval of all equipment and working drawings was consummated by the Sewage Disposal Section of the office of the City Engineer. Approximately 2300 drawings were reviewed and approved during the course of the construction period. A. D. Caster is principal engineer of the Sewage Disposal Section.

Advanced Training Courses Offered by U.S.P.H.S. At Cincinnati

The Sanitary Engineering Center, with headquarters in Cincinnati, Ohio, has the primary responsibility in the Public Health Service for the conduct of research and investigations in the field of environmental sanitation and water pollution control. As a part of its program, the Center also conducts training activities covering the fields of radiation hygiene, water pollution control, sewage and waste treatment, and water purification.

The technical training courses offered at the Center are designed for professional personnel from State and local health departments, water pollution control agencies, the Public Health Service, and other governmental units. Industrial representatives who are cooperating with these agencies also are eligible to attend. Following are advanced training courses now planned:

September 15-17: Short Course in Fluoride Analysis.

September 29-October 1: Seminar on Individual Household Sewage Disposal Systems.

November 29-December 10: Advanced Training for Sanitary Chemists in Water Pollution Investigations.

January 10-14: New Techniques in the Bacteriological Examination of Water.

February 16-18: Short Course in Phenol Determinations.

March 7-18: Advanced Training for Sanitary Engineers in Water Pollution Abatement Programs.

May 16-20: Aquatic Biology Training.

May 23-25: Bioassay of Industrial Wastes.

June 6-10: Short Course in Air Pollution Problems.

Dates are to be announced for an Emergency Sanitation Training Course which will be scheduled if sufficient requests are received.

For complete details write to V. G. MacKenzie, Officer in Charge, Sanitary Engineering Center, Cincinnati 26, Ohio.

Cleveland's Industrial Wastes Problem Being Tackled by Case Institute

$150,000 Fund Largely Industry's Contribution

Case Institute of Technology has entered upon a three-year program of study and research looking to the most satisfactory and economical methods of solving the problem of industrial pollution in the Cleveland area.

The program, proposed by Case as a service to Cleveland industry, was studied and endorsed by the special Committee on Industrial Wastes of the Cleveland Chamber of Commerce, which received the encouragement of the Ohio State Dept. of Health in its deliberations.

Funds to support the initial three-year program have come from a number of Cleveland's larger industries and from supplementary funds from Case Institute to provide a total of $150,000 as a starter for the three-year period.

The new work will be conducted under the direction of Prof. Geo. E. Barnes in the Dept. of Civil Engineering at Case, and centered in the present Laboratory of Sanitary Engineering where industrial waste studies have already been conducted, and which will now be further enlarged, equipped and staffed for the considerably enlarged undertaking.

Among the objectives already set for the Case Institute program is that of determining to what extent various industrial wastes can be assimilated by existing processes of sewage treatment —i.e., disposed of through municipal sewers and sewage treatment plants, with or without enlargement of the latter, or requisite changes in processes employed in municipal sewage treatment in order to care for increasing industrial waste loadings.

It is pointed out by Case authorities that this new undertaking comes at a particularly appropriate time when the new Water Pollution Control Act of Ohio is requiring industry to get down to serious business in reducing stream pollution, while operating under temporary permits providing maximums in respect to waste discharges by individual industrial plants or factories to specific water courses.

Merle J. Trees Dies: CB&I Chairman

Merle J. Trees, 71, Chairman of the Board of Chicago Bridge & Iron Company, died on August 6 in Chicago, Illinois. Mr. Trees started as an estimator and contractor for Chicago Bridge in 1910, and in 1945 was made Chairman of the Board.

Talent for Success

Attaining success is nothing more than what you can do well. And, without thought of fame, doing well whatever you do.

Financing Municipal Sewerage

A suggested method by which those most benefited may participate in financing sewerage projects

by **GEORGE L. HALL**, *Sanitary Engineer, Baltimore, Md.*

IN MANY states a serious problem has developed during recent years in raising funds for the construction of municipal sewer systems and/or sewage treatment plants. Many municipalities, particularly the smaller ones, where such projects are contemplated either voluntarily or under pressure from state water-pollution control agencies, have found that the cost of constructing these works is either beyond the financial ability of the municipality or the annual charges to amortize the bonds and to operate the project place an undue burden upon the local taxpayers. To a certain extent this condition is the result of high construction costs when compared with those obtaining in earlier years. Furthermore, no financial aid is now available from the federal government; and, as the taxable bases of many municipalities are still too low, the cost of these projects in relation to the taxable bases is high.

In some instances on record, costs for sewerage improvements have ranged anywhere from 15 percent to more than 35 percent of the taxable basis. Under such conditions, therefore, it would be difficult, if not impossible, to float a bond issue for the project; or, if bonds were sold they would carry such a high rate of interest that a heavy financial burden would be imposed upon the taxpayers.

Current Methods of Financing Sewerage Projects

The methods generally used for financing sewerage projects are many and varied in different sections of the country. Bonds may be amortized by income derived from front-foot benefit charges; sewer-service charges; ad-valorem taxes; sewer rentals; a charge based upon the computed or metered quantity of water used or the amount of the water bill; the number and kind of plumbing fixtures in use; upon any other factor affecting the use of the sewerage system; or upon any combination of these charges. In the long run the total annual cost to the individual property owner is approximately the same regardless of the method used for raising funds for bond-amortization purposes. It is evident, at least in some states, that a degree of financial aid must be given to many municipalities if real progress is to be made in correcting stream pollution resulting from the discharge of raw or inadequately treated sewage into nearby watercourses. Some states have participated in such a program of financial assistance in an endeavor to meet these needs by offering grants-in-aid for the preparation of contract plans and specifications for sewerage projects. Such a program has considerable merit but, in the writer's opinion, does not go far enough in promoting a clean-stream program. Actually, the cost of engineering is a relatively small part of the over-all cost of the project.

The foregoing is, perhaps, just another statement among the many which have appeared in the past decrying the situation existing among municipalities faced with sewerage problems, but most of which do not seem to offer much that is really new in the way of a solution.

The result of a long association which the writer has had with many municipal authorities, seriously striving to solve the local stream-pollution problem, have shown that financial aid for the construction of sewerage projects is necessary if this objective is to be attained. Furthermore, faster progress will be made in accomplishing a realistic solution if a practical plan of financial aid can be devised.

Possible Sources of Financial Aid

Rather than securing aid from the federal government, as was the case some years ago, with many states having only a part of the total paid by the taxpayers to the federal government returned to them for the construction of public works projects, would it not be more advantageous for each state to independently raise funds in some manner to assist its political subdivisions in carrying out a statewide clean-stream program? All but a fractional percent of funds so raised would then be available for financing the construction of the most needed sewerage projects. This broadened concept of responsibility of the citizenry of a state as a whole, for stream conditions within its own borders, is but a substitution of the authority exercised by the federal government when it offered grants-in-aid to governmental subdivisions, except that in this case the state would raise and grant its own funds to its own municipalities.

If a state-wide clean-stream program were established by the proper state authority, it would be possible for each state to undertake a long-

My main purpose in writing this article is simply an endeavor to promote the idea of a state-wide clean-stream program. Since the watercourses within the boundaries of a state are either owned by the state or are under its control, the cost of maintaining them in a clean condition, it seems to me, should be shared in part at least by all of the state's population. It is probably true that in most states the residents therein, or the majority of them, make use of the streams in one way or another and it does not appear too illogical that they should assist in a small way in the clean-stream program.

It might be argued by some that the gasoline tax for state highway construction is not a fair tax in that many of the taxpayers never have the opportunity of using certain of the improved roads which their money has helped to build. This tax, however, makes it possible to undertake a state-wide highway improvement program which is of benefit to all persons using the state highway system.

The plan suggested in this article is one which will permit some of the groups which have been most articulate in demanding clean streams to have the opportunity to participate in a small way in an overall state-wide stream improvement program.

—G. L. H.

range plan for cleaning up pollution of streams. A precedent for state-wide financing of public improvements is found in highway building. Practically all states pay for a large part of the highway-construction program within their boundaries with funds derived from a gasoline tax. In many states the construction of schools is financed, in part, with state funds. The streams of the state are widely used by practically all of its citizens for many recreational purposes, including fishing and, in some of the tidewater states, for shellfish propagation. Beneficial results would accrue to all of these uses and to others, if sewage pollution in the watercourses were relieved. Is it not equitable, then, that the users of these streams should help to keep them in good condition just as do the users of the state highways?

One Direct Source of Funds

An example of how funds might be raised to provide aid to correct sewage pollution, which would seem to the writer to distribute the financial load in a more equitable manner so that all users of the streams would contribute toward this end, is illustrated in the following:

Assume that an average-size state, on tidewater, which has a taxable basis of five billion dollars, issues 100,000 fresh-water fishing licenses and 60,000 hunting licenses each year, and has an annual production of 2,000,000 bushels of shellfish from its tidal waters. If the state tax rate is increased one cent, and fifty cents is added to each fishing and hunting license and a two-cent tax is levied on each bushel of oysters, an annual sum of $620,000 would be raised.

Allocations from this fund, in the form of annual grants-in-aid to municipalities, could be made to assist them in amortizing bonds for the construction of systems of sewers and/or sewage treatment plants. Under this plan, it is suggested that not more than 50 percent of the annual bond-service charges be given to any municipality. The total amount of each grant should depend upon the financial condition of the prospective grantee. As the maximum grant would be equal to approximately one-half of the interest and retirement charges for each bond issue, the total annual sum that would thus be made available to finance bonds for state-wide sewerage projects would be a tidy $1,240,000.

Assuming that 3½% 40-year serial bonds are to be issued and that each municipality is given a maximum grant of 50 percent, sewerage projects totalling in cost approximately $26,000,000 could be financed. This total is a minimum figure as the grant-in-aid to each community participating in the plan would not necessarily amount to as much as 50 percent of the annual charges because some municipalities are in much better financial condition than others.

The plan suggested thus far for the state's part in the raising of funds for the state-wide clean-stream program, is not applicable throughout the country. Annual assessments for many other recreational uses of a state's waters are available, but in this discussion no attempt is made to point them out.

In the fiscal year of 1953 nearly 15,000,000 hunting licenses were sold by the 48 states, according to the U. S. Fish and Wildlife Service, and it is probable that almost as many fresh-water fishing licenses were issued. Relieving the streams of the country from sewage pollution would make more streams available for fishing and other recreational uses and would provide an opportunity for those using the streams to participate in a small way in the over-all program on a state-wide basis.

Sewered communities have only one way to take care of sewage; that is by discharging it into the nearest watercourse. The required degree of sewage treatment depends upon many factors, but mainly upon the ability of the stream to assimilate the sewage effluent and the down-stream uses that are made of the stream. It is not always possible, however, for all communities to provide the required degree of treatment because of financial limitations. A state-wide program under which the carrying charges for sewage works bond issues are reduced 50 percent, would provide a real incentive to correct sewage pollution of streams and, at the same time, would be of material assistance to the stream pollution authorities in carrying out their responsibilities.

Advantages to be Realized

Some of the advantages of the state-wide clean-stream program plan are:

1—A long-range program could be undertaken without delay.
2—Participation in a program would be shared by all of the citizens of the state.
3—A lower interest rate on sewage works bond issues would presumably result with state participation in the plan.
4—A maximum reduction of 50 percent in the annual carrying charges for the bond issues would inure to the participating municipalities.
5—It is believed that many more municipalities, where the construction of sewerage projects is needed, would more willingly undertake them without the often needed pressure from pollution-control agencies.

As the taxable basis of the states increase, more funds would be made available to carry out the plan and, since a delay would occur before all of the income is allocated, more construction than the estimated $26,000,000 could be undertaken.

The plan here presented provides a means for a solution of the present serious difficulties in which officials of many municipalities find themselves when faced with financing sewerage projects. It permits the participation of all of the state's population, with greater participation by those standing to gain most from cleaning up intra-state stream pollution.

W&SW

D. P. Schiesswohl Becomes FS&IWA Executive Assistant

Donald P. Schiesswohl of Jacksonville, Florida, became Executive Assistant in the headquarters staff of the Federation of Sewage and Industrial Wastes Associations effective August 16. This position was newly created by the Federation Board of Control.

Mr. Schiesswohl comes from the Bureau of Sanitary Engineering, Florida State Board of Health where he has been a sanitary engineer for several years. Up until recently he was assistant to the chief of the Sewage and Industrial Wastes Section of the Bureau.

He holds membership in the American Society of Civil Engineers where he was active in the Florida section having been a vice-president and editor of the section's news-letter. He is a registered professional engineer, a member of the Florida Engineering Society and of Phi Kappa Phi.

Prior to coming with the Florida State Board of Health, Mr. Schiesswohl held the position of assistant professor in sanitary engineering at the University of Kansas.

WATER WORKS PRACTICES

Loss of Head

The Fifteenth in a Series

by **GEORGE E. SYMONS, Ph.D., Consultant & Technical Editor**
Larchmont, N. Y.

IN WATER WORKS practice, there are many times when an engineer or operator is confronted with a problem in loss of head. Therefore, it is important to know something about the subject.

A . . . Fundamentals

1 . . HYDRODYNAMIC PRINCIPLES

a. From the general principles of hydrodynamics (flow of liquids), it was learned that power or energy in flowing fluids exists because of elevation, velocity of movement, applied pressure, or any combination of the three.

b. Each of these causes of energy can be converted into the other two and any one of these three energy producing factors can be expressed in terms of head, in feet, or pressure, in lb per sq in (psi).

c. The total energy (or total head), at any point, in a liquid in motion is equal to the sum of these three energy producing factors.

d. In any system involving the flow of a liquid, there is a decrease in total head, as the liquid moves from one point to another, except where energy, or head, is added by a pump.

e. This decrease in energy or head is known as "loss of head," sometimes called head loss.

2 . . CAUSES OF LOSS OF HEAD

a. Decrease in head between two points in a system is caused by friction.

b. Friction is caused by (1) roughness of the material or pipe through which the liquid is moving, (2) interference to flow caused by valves, elbows, and fittings, (3) turbulence, and (4) friction forces within the liquid itself.

3 . . IMPORTANCE OF LOSS OF HEAD

a. If there were no friction, that is, no loss of head, water introduced into any system would have the same pressure at the point of discharge as at the original point of entry.

b. In any distribution system, the volume of water discharged at a tap will be directly proportional to the head at that point. In order to maintain a desired head (pressure) at any point, power (energy) must be supplied to overcome the loss of head in the system.

c. The greater the loss of head, the greater the amount of power required to pump the water and the less efficient and more costly the pumping operation. Even in gravity flow systems, loss of head due to friction, caused by tuberculation, will decrease the volume of flow, that is, the carrying capacity of the system will decrease below that desired.

d. In filter plants, loss of head through filters is a measure of the filtering capacity, and an indication of the need for washing.

e. In the selection of metering devices, as well as valves, the permanent loss of head of the device is an important characteristic to be considered, because loss of head means increased pumping power required.

B . . . Loss of Head in Full Pipes

1 . . BASIC EQUATION OF HEAD LOSS

a. In water works practice most of the loss of head problems occur in pipes flowing full and the discussion and formulas in this section refer to pipes flowing full.

b. According to Russell's "Hydraulics" and King's "Handbook of Hydraulics," resistance to flow (i.e. friction) is:

(1) Independent of pressure under which liquid flows
(2) Directly proportional to length of pipe
(3) Variable with some power of the velocity
(4) Inversely proportional to some power of the pipe diameter
(5) Variable with the roughness of the pipe if the flow is turbulent

c. The equation for loss of head is

$$h = K\frac{lv^n}{d^x} \qquad \text{Eq. 1}$$

where h = head loss in ft
K = proportionality constant affected by roughness of pipe if flow is turbulent
l = length in ft
v = velocity in ft per sec
d = diameter of pipe in ft

(1) The value of "n" varies between 1.7 for smooth pipe and 2.0 for rough pipe for turbulent flow; it is 1.0 for laminar or non-turbulent flow.

(2) The factor x varies from 1.0 to 1.3 for turbulent flow; it is 2.0 for laminar flow.

d. Thorough discussions of loss of head and the factors which affect it, particularly the importance of Reynolds Number, may be found in standard texts on hydraulics.

2 . . HAZEN-WILLIAMS FORMULA

a. Most commonly used formula for loss of head in water lines is that developed by Hazen and Williams in 1905. This formula is a variation of Eq. 1 with "d" expressed in terms of the hydraulic radius "R" (area of pipe divided by the wetted perimeter); introduced into the formula is the term "S" or hydraulic slope for

This article is one of a series on the general subject of "Water Works Practices," developed by Dr. Symons in the simple style of a short course lecture and designed to be of interest to small plant operators, new operators, students and many others who may wish to review the fundamentals of the subject.—*The Editors*

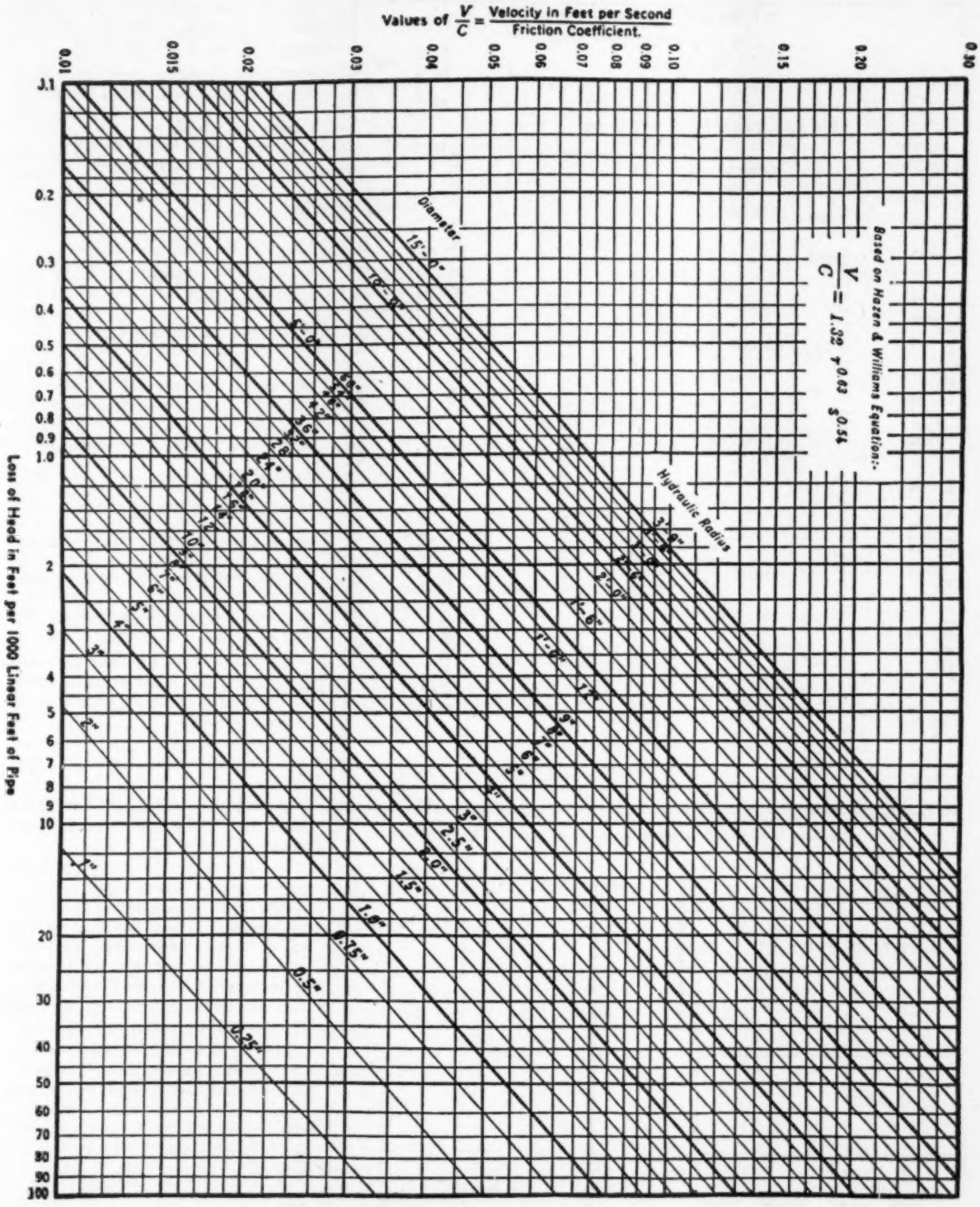


Fig. 1—LOSS of head chart per 1000 ft of pipe (Creager)

the term h/l (head loss divided by length).

b. The Hazen-Williams formula is

$$V = CR^{a}S^{b} \qquad \text{Eq. 2}$$

or $V = CR^{0.63}S^{0.54}0.001^{-0.04}$

or $V = 1.318\,CR^{0.63}S^{0.54}$

where V = Velocity of flow in ft per sec
C = Coefficient of retardation
R = Hydraulic radius of pipe or diameter D/4, in ft
S = Hydraulic slope in ft per ft of pipe

c. A variation developed in 1920, by Scobey for concrete pipes has the formula

$$V = C_s H^{0.5} d^{0.625} \qquad \text{Eq. 3}$$

where V = Velocity
C = coefficient
H = head loss
d = pipe diameter in inches

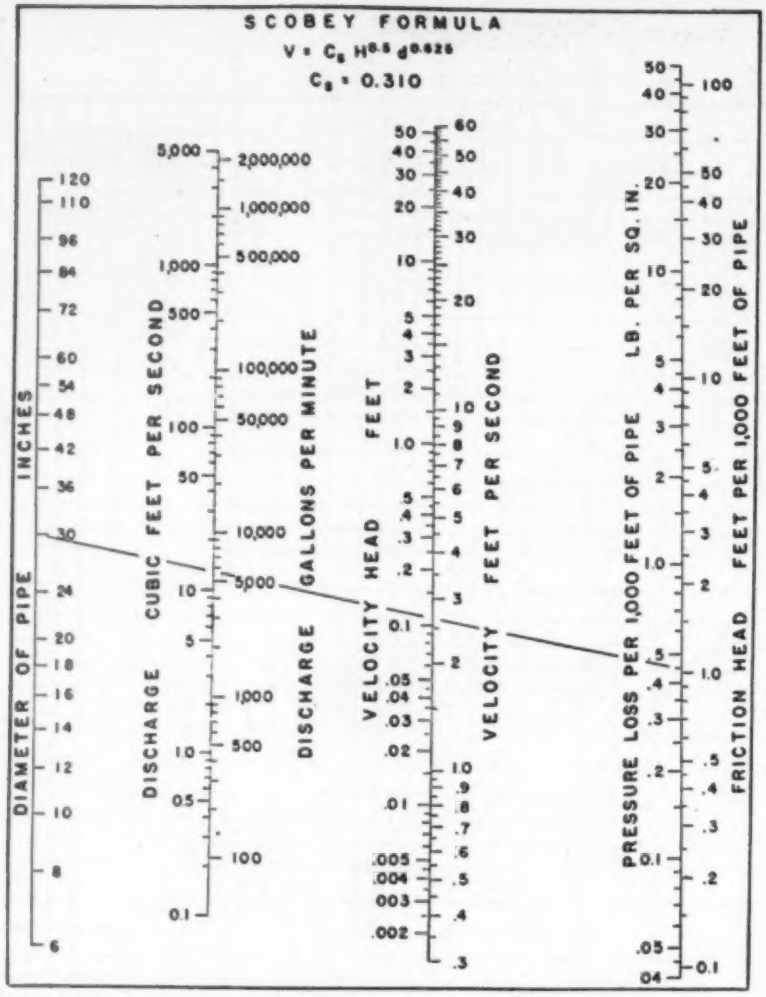

SCOBEY FORMULA
V = C_s $H^{0.5}$ $d^{0.625}$
C_s = 0.310
DIAMETER OF PIPE INCHES
DISCHARGE CUBIC FEET PER SECOND
DISCHARGE GALLONS PER MINUTE
VELOCITY HEAD FEET
VELOCITY FEET PER SECOND
PRESSURE LOSS PER 1,000 FEET OF PIPE LB. PER SQ. IN.
FRICTION HEAD FEET PER 1,000 FEET OF PIPE

Fig. 2—LOSS of head and flow chart for concrete pipe (J. R. Griffiths)

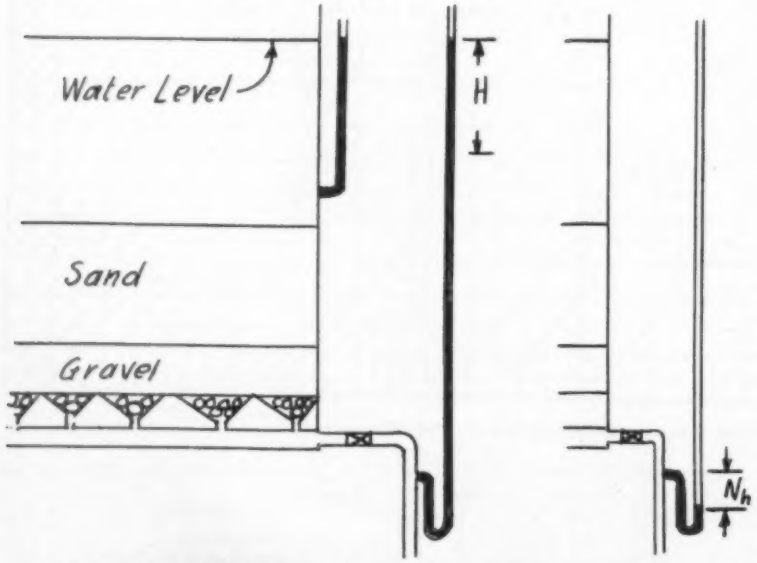


Fig. 3—SCHEMATIC diagram of loss of head and negative head in filters (H — Loss of head; N — Negative head)

d. Another variation is an adaptation of Manning's flow formula for open channels. It has the form

$$V = \frac{0.590}{n} d^{2/3} s^{1/2} \qquad \text{Eq. 4}$$

where V = velocity
n = coefficient of roughness (same as Kutter's n)
d = pipe diameter
s = hydraulic slope

3 . . "C" Values

a. Standard values for C are generally given as:

Pipe	C Value
Extremely smooth straight C.I. Pipe (or Cement Lined Pipe)	140
Very smooth straight C.I. Pipe (tar dipped)	130
New Riveted Steel Pipe	110
Asbestos-Cement Pipe	140
Smooth Wood or Wood Stave Pipe	120
Vitrified Pipe	110
Concrete Pipe—best workmanship	150
Concrete Pipe—poor workmanship	90

b. Values of "C" decrease with age; after about 20 years, a value of C = 100 for C.I. pipe is to be expected.

(1) The larger the pipe, the smaller the decrease in "C" value with pipe age.

(2) If pipes are slimed or tuberculated, the "C" value decreases more rapidly.

c. Since the carrying capacity under a given power input varies directly with the loss of head in a pipe, any increase in head loss (or decrease in "C" value) means either that more power will be required for pumping to maintain the desired discharge, or that the carrying capacity and discharge will decrease.

d. Regular determination of the "C" value for transmission mains, distribution mains, pipes, etc., will indicate the need for main cleaning.

4 . . Equivalent Pipes

a. Two pipes of different sizes are called equivalent pipes when they have the same roughness coefficient and the losses of head in them are equal for equal rates of flow. Two systems of pipes (or one pipe and a pipe system) can also be compared on the equivalent pipe basis.

b. Table 1 from an article by C. W. Booth in 1944, published in the

AWWA Journal, shows the lengths of a number of equivalent pipes.

c. Where grid systems are used, problems of loss of head in the system are more complicated than for single or simple equivalent pipe lines.

(1) Analysis of the loss of head can be made by the equivalent pipe method, wherein the loss of head in a loop or at any point on the system is determined in terms of an equivalent piece of straight pipe. Graphs and nomograms are available for the solution of such problems. Many have been published in *Water & Sewage Works*.

(2) The Hardy-Cross method of analyzing loss of head in pipe grid systems is frequently used. Its application has been simplified by D. R. Taylor in 1943 in *Waterworks & Sewerage*. Reference should be made to that article for details of how to use the method.

(3) A third method of solving loss of head problems in pipe grid distribution systems is by an electronic device called the McIlroy Flow Analyzer, the description of which appeared in the AWWA Journal in April 1950.

d. Detailed information on the use of various methods of analyzing loss of head in distribution systems can be found in *Water & Sewage Works* (See Reference No. 5, this lecture) and other technical magazines.

5 . . Useful Tables and Graphs

a. A standard graph for determining loss of head according to the Hazen-Williams formula is shown in Fig. 1. It was originally prepared by Wm. P. Creager and published in the "Hydroelectric Handbook" by Creager and Justin.

b. A nomograph for the Scobey formula is shown in Fig. 2. It was developed by J. R. Griffiths, in *Western Construction News*.

c. D. R. Taylor (*Waterworks and Sewerage*, 1943) developed two nomographs and several tables for ease in determining loss of head in pipes.

d. Simple slide rules for determining loss of head in pipe lines are available on request and may be obtained from the Cast Iron Pipe Research Assn., 122 So. Michigan Ave., Chicago 3, Ill., and from the Grinnell Co., Providence, R. I.

C . . . Loss of Head in Valves, and Fittings

1 . . Valves

a. Valves are used in pipe lines, either to shut off flow or to control it.

b. Flow through valves is altered by the obstruction introduced by the valve itself; velocity is changed; turbulence is magnified; and loss of head results.

c. If a valve is used for control, the loss of head varies with the extent of valve closure and the loss is mainly due to sudden contraction in the stream followed by sudden enlargement.

d. Loss of head values increase with an increase in velocity of flow. Loss of head values differ for each type of valve. In general, the relative loss of head (descending order) for valves of the same size at the same velocity of flow will be in this order: Globe valve, angle valve, check valve, butterfly valve, cone valve, gate valve.

2 . . Fittings

a. Pipe fittings and connections, bends, elbows, tees, wyes, reducers,

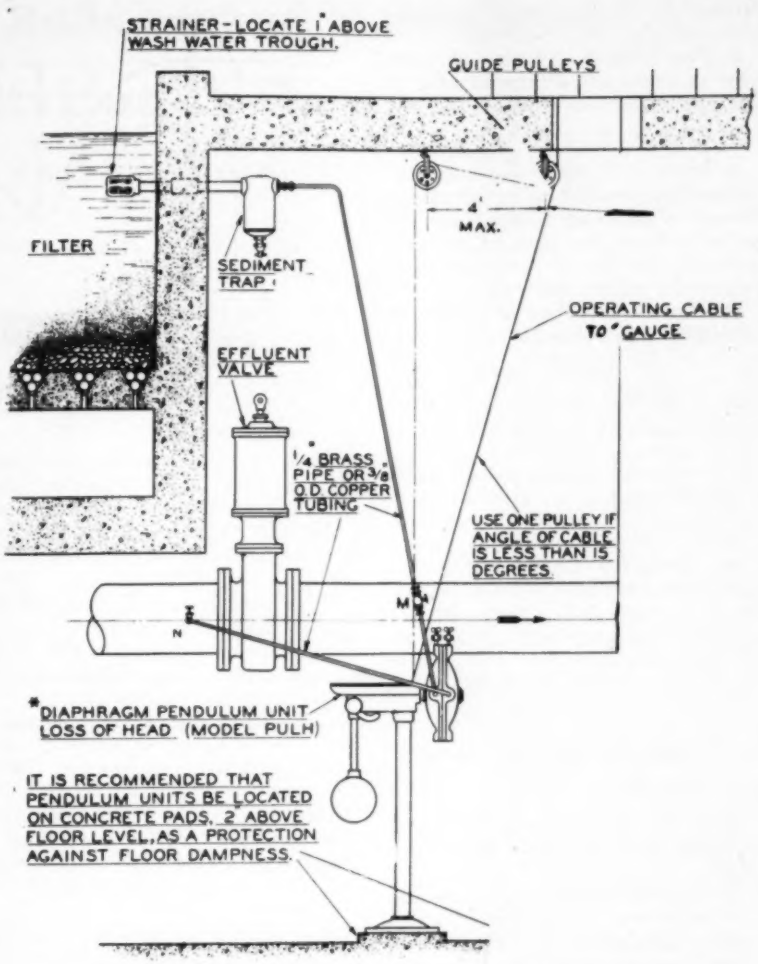

STRAINER - LOCATE 1' ABOVE WASH WATER TROUGH.
GUIDE PULLEYS
4' MAX.
FILTER
SEDIMENT TRAP
OPERATING CABLE TO GAUGE
EFFLUENT VALVE
1/4 BRASS PIPE OR 3/8 O.D. COPPER TUBING
USE ONE PULLEY IF ANGLE OF CABLE IS LESS THAN 15 DEGREES.
M
N
*DIAPHRAGM PENDULUM UNIT LOSS OF HEAD (MODEL PULH)
IT IS RECOMMENDED THAT PENDULUM UNITS BE LOCATED ON CONCRETE PADS, 2' ABOVE FLOOR LEVEL, AS A PROTECTION AGAINST FLOOR DAMPNESS.

Fig. 4—DIAGRAM of loss of head measurement by diaphragm pendulum unit

(TABLE 1)

Lengths of Equivalent Pipes in Feet

(Based on Hazen-Williams Formula)

Dia-in.	4	6	8	10	12	16	24	36
4	1.0							
6	2.9	1.0						
8	6.19	2.14	1.0					
10	11.12	3.84	1.8	1.0				
12	18.0	6.21	2.9	1.61	1.0			
16	38.4	13.3	6.19	3.45	2.14	1.0		
24	111.2	38.4	18.0	10.0	6.19	2.9	1.0	
36	323.	111.2	52.2	29.0	18.0	8.42	2.9	1.0

flanges, etc., all create some head loss when installed in a pipe line.

b. The relative position to each other of valves and fittings affects the total loss of head in a line.

3 . . Equivalent Pipe Concept

a. In order to establish a basis for comparison, loss of head in valves and fittings is determined and stated in terms of equivalent pipes; that is, in terms of the loss of head in some length of a definite sized pipe.

b. The formula used to determine equivalent pipe losses is

$$H = K\frac{V^2}{2g} \qquad \text{Eq. 5}$$

where H = Head loss in ft
K = coefficient
V = Velocity in ft per sec
2g = 64.4

c. Values for the coefficient "K" have been established by various authors; curves and nomograms are available for easy determination of the equivalent head loss. (See *Water & Sewage Works*, p. R-100, May 1954.)

D . . . Other Problems in Loss of Head

1 . . Open Flow

a. Losses of head in open channels or conduits are analogous to losses in pipes.

b. Loss of head is continuous and gradual; it is caused by friction which occurs throughout the channel. If there is an abrupt change in velocity or direction, there is an abrupt increase in loss of head.

c. Loss of head is taken into account in the formulas for open channel flow. (See Chezy and Manning formulas in the previous lecture on "Flow Measurement.")

2 . . Loss of Head in Filters

a. Frictional resistance to the movement of water through a sand filter causes loss of head.

b. Loss of head in a filter is equal to the vertical distance between the surface of the water in the filter and the elevation of the hydraulic grade line at the filter outlet.

(1) Elevation of the hydraulic grade line at the filter outlet is determined by placing a piezometer tube in the effluent pipe and measuring the height of the water in the tube. (See Fig. 3.)

(2) Loss of head gauges may operate from a float in a well connected to the effluent line, or preferably from a diaphragm pendulum unit. (See Fig. 4.)

c. Factors which affect loss of head are size of sand particle, depth of sand and gravel, type of underdrain system, and, of course, clogging due to dirt and floc particles on the filter sand surface and between the sand grains.

(1) Filters are usually designed so that the loss of head, when the filter is clean, is not more than 1 to 2 ft. The maximum loss of head obtainable is 12 to 15 ft.

(2) Several types of filter bottoms have been designed to minimize the loss of head due to that factor. These will be discussed in the lecture on filtration.

d. The longer the filter is in operation, the more it tends to become dirty, and the more the loss of head increases.

(1) Manual or automatic control of rate of flow is necessary to offset the increased loss of head as the filter becomes dirty and thus to maintain a constant rate of flow through the filter.

(2) When the loss of head has reached an allowable limit (usually 8 to 10 ft), the filter has reached its effective capacity and should be washed. The guide to the need for filter washing is the loss of head gauge.

e. Negative head (Fig. 3) is a measure of vacuum within a filter, if the loss of head exceeds the depth of water to that point in a filter, air binding may result; this problem will be discussed in a future lecture on filtration.

3 . . Loss of Head in Meters

a. Measuring devices, both main line and service meters, offer obstructions to flow and cause loss of head.

b. In the design of main line meters, the object is to minimize the loss of head through the device. Figure 5 shows the hydraulic grade line and permanent loss of head for a Venturi tube meter. The Dall Flow Tube has a lower permanent head loss than the Venturi Tube; other devices have a higher permanent head loss.

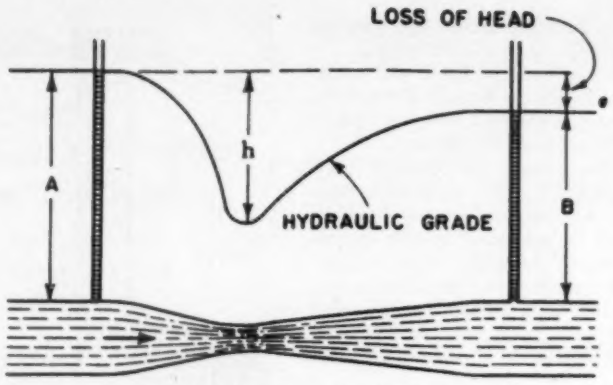


Fig. 5—DIAGRAM of loss of head in Venturi tube

c. Service meters have an appreciable head loss. In a ⅝ in. meter the loss of head will vary from 0 to 10 psi for flows of 0 to 20 gpm. The loss of head curve is not a straight line but increases more rapidly as the rate of flow increases.

E . . . References

Material for this lecture was obtained from these sources:

1. Babbitt and Doland, "Water Supply Engineering" (McGraw-Hill).
2. King, H. W., "Handbook of Hydraulics" (McGraw-Hill).
3. Russell, Geo. E., "Hydraulics" (Holt).
4. Steel, E. W., "Water Supply and Sewerage" (McGraw-Hill).
5. *Water & Sewage Works*, "Loss of Head in Pipes and Fittings," Vol. 101, No. 5 (Ref. and Data Ed. p. R-96; May 1954).

Next Lecture—Pumps and Pumping

Research on Chemicals Considered Possible Cancer Sources

According to press reports, several medical doctors speaking at the Sixth International Cancer Congress at Sao Paulo, Brazil, recommended that certain chemicals in food, air, and water should be more intensively investigated as potential agents causing cancer.

Dr. W. C. Heuper, of the National Cancer Institute, Bethesda, Md., said research shows potential hazards from certain chemical elements in the United States shale oil industry and new methods of making synthetic oils. Heuper said that water and air are being studied to learn if cancer-causing chemicals are being released by industrial and other operations.

Designing, Building and Maintaining Centrifugal Pumps

Part 2—Pump Casings

by ROY CARTER and IGOR J. KARASSIK, Engineers
Worthington Corp., Harrison, N. J.

IN THE OPERATION of a centrifugal pump, the liquid is discharged by the impeller at high velocity. One function of the pump casing is to reduce this velocity and convert kinetic energy into pressure energy. This can be accomplished (see Part 1) either by a volute or by a set of diffusion vanes. In present day designs, the volute type casing is the more commonly used except for (1) the very high pressure multistage units, (2) the vertical turbine pumps and (3) the propeller type pumps. In a volute type casing, the area increases from the initial point until a full 360° is encompassed around the impeller, and the casing is then flared out to the final discharge opening.

In a diffuser type casing, the impeller discharges the liquid into a number of ports formed by vanes. These ports increase in area and discharge the liquid, usually into a concentric casing, at a reduced velocity. The diffuser type casing (having a number of fixed vanes in the path of the water leaving the impeller) can operate without shock at only one capacity, that at which the angle of flow from the impeller matches the angle of the vane. At other flows, shock and turbulence results—often with adverse effects on the performance.

In a volute pump, since no vanes are involved, the change (with capacity) in the angle at which the liquid leaves the impeller results in the liquid following a different path—but without any marked turbulence.

Radial Thrust Effect

If a volute pump is operated at other than its design capacity a certain unbalance of the hydraulic forces acting radially on the impeller results, with maximum unbalance occurring at zero-capacity. As such an unbalance results in a radial load on the shaft, the shaft design of the pump must be suitable for maximum loading over the operating range of the pump. Normally the operating range is not wide, but occasionally pumps are installed in systems where operation may be from in excess of rated capacity to almost zero. In some instances of this nature, even with single stage pumps, shaft failures have occurred because such part-capacity operation was not contemplated by the designer selecting impeller size and speed involved.

While the same tendency for unbalance exists in the diffuser type of pump, the reaction is over only a small arc and is repeated all around the impeller. As a result the various reactions offset each other.

One means used to combat the effects of radial thrust in volute type pumps is the twin-volute construction illustrated in Fig. 1. A twin-volute is, in effect, two half-capacity volutes, each taking the discharge from a 180° arc of the impeller. Of course, it must be recognized that the twin-volute cannot eliminate the radial thrust of a single stage pump entirely, since

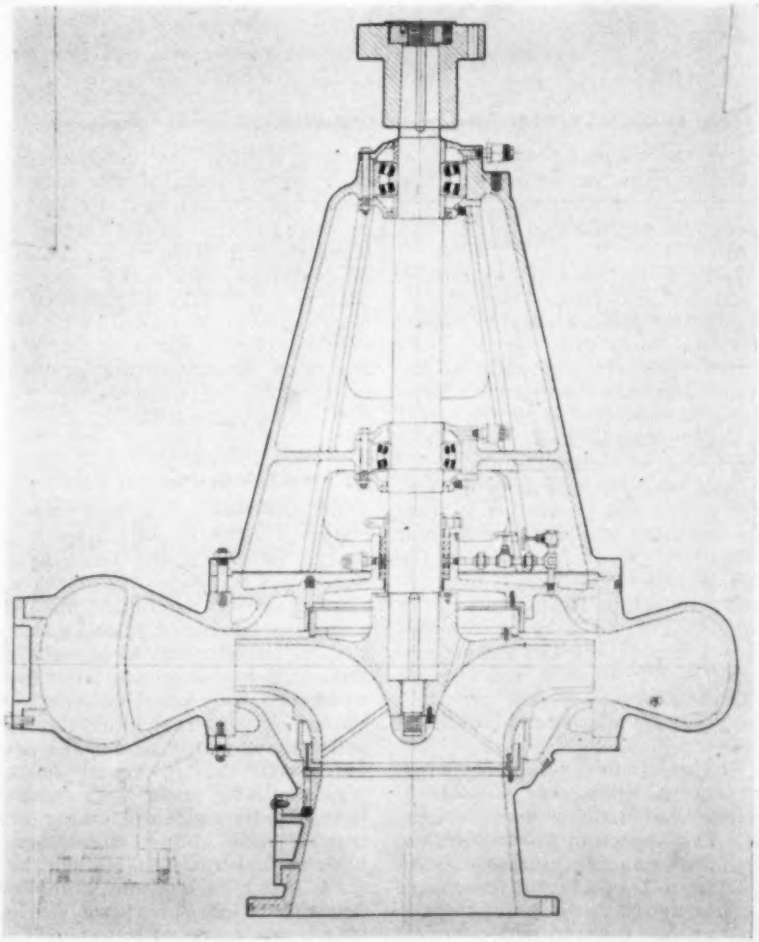


Fig. 1—SECTIONAL view of a vertical-shaft, end-suction pump having a twin-volute casing.

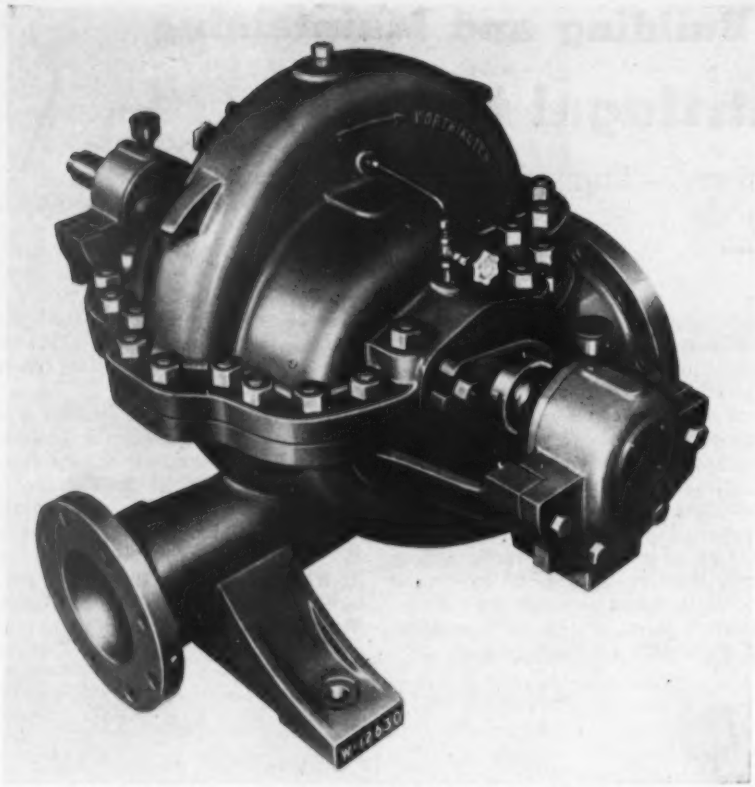


Fig. 2—AXIALLY-SPLIT casing, horizontal shaft, double-suction volute pump.

one of the volutes discharges into a straight discharge nozzle while the second discharges into the curved channel formed by the first volute.

From a technical viewpoint, it could be questioned whether a twin-volute pump should be classified as a volute pump or as a two-ported diffuser. The twin-volute design has many potential advantages, particularly in the large capacity, medium and high head single stage vertical pump applications, as the rib forming the second volute and separating it from the discharge waterway of the first volute adds to the strength of the casing. The twin-volute is not generally applicable in smaller sizes of pumps. This is because of difficulties in cleaning the casing passages in the foundry and because of the increase in wall area and the resulting increase in frictional losses.

The twin-volute design does not, at present, seem very suitable to axially split double suction designs. The first objection arises from the fact that pumping applications requiring units of a large enough size to warrant this design, generally can utilize the more economical vertical shaft end (bottom) suction type of construction. Another objection is that the conventional design of horizontal double suction pump has a horizontal discharge; its casing is split in the horizontal plane, the split of the casing coming approximately 90° from the tongue of the volute. As this makes it necessary to have part of both volutes split by the joint, there is a serious manufacturing problem in matching the waterways of the two casing halves.

Solid and Split Casings

In centrifugal pump nomenclature, "solid casing" implies a design in which the discharge waterways leading to the discharge nozzle are all contained in one casting or fabricated piece. In order that the impeller may be introduced into such a casing, the latter has to have at least one side open. As the sidewalls surrounding the impeller are in reality part of the casing, a solid casing, strictly speaking, cannot be used. Thus designs normally termed solid casing are really radially split casing designs. (See Figs. 1 and 3.)

By "split casing" it is implied that the casing is made of two or more parts fastened together. The term "horizontally split" was devised to indicate the casing construction usually employed with horizontal shaft double suction pumps, and to show that the casing was divided on a horizontal plane through the shaft centerline or axis. (Fig. 2) That designation was an unfortunate choice, as applications of the same design of pump for vertical use or with a rotated nozzle position confused the terminology. Many design engineers now prefer the terminology "axially split" for this type of construction. As both the suction and discharge nozzles normally are in one half of the casing, this construction permits the removal of the other half (upper half in the case of horizontal shaft pumps) for examination of the interior without disturbing the bearings or the piping.

Like its counterpart "horizontally split," "vertically split" is poor terminology. It is intended to refer to a casing which is split in a plane perpendicular to the axis of rotation. The term "radially split" is now being used by some designers to designate this type construction.

In some special applications of horizontal shaft pumps, it is desirable to use a casing split along a plane passing through the pump axis but inclined diagonally to the horizontal. This construction is used primarily in horizontal shaft pumps, in such pumps a vertical discharge is necessary, and yet the convenience of an axially split casing is desired to permit internal examination of the pump.

End Suction Pumps

Most end suction single-stage pumps are made with one piece or so-called "solid" casings. At least one side of the casing must be open so the impeller can be assembled in the pump, thus necessitating a cover for that side. If the cover is on the suction side, it contains the suction opening as well as forming the side wall of the casing. This is called the suction cover or casing suction head.

Some designs of end-suction single-stage pumps having solid casings are built with casing suction covers for impeller removal, as in Fig. 3; others are made with stuffing box covers; and still others have both casing suction covers and stuffing box covers, as in Fig. 1.

For general service, the end-suction single-stage pump design is extensively used for small pumps up to 4-in. and 5-in. discharge size, both for the motor mounted type and for coupled types. In all these

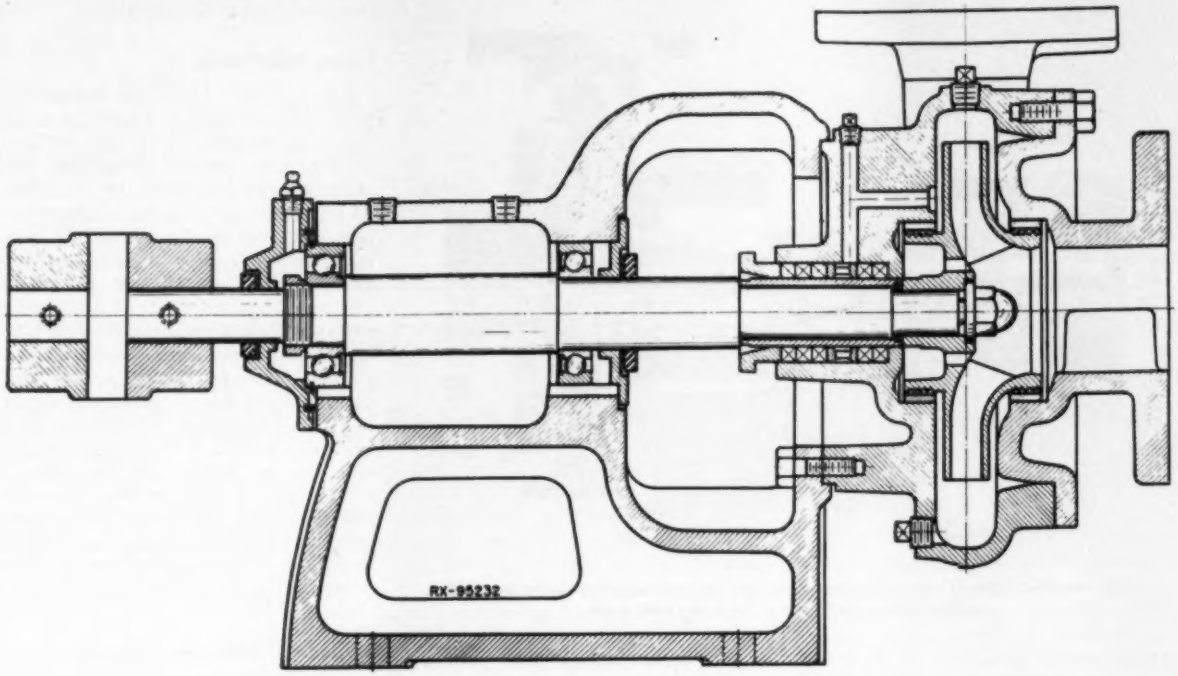


Fig. 3—SECTIONAL view of end-suction pump having radial-split casing with suction cover.

types, the small size makes it feasible to cast the volute and one side integrally. The choice of whether the stuffing box side or the suction side is made integrally with the casing usually is determined by the general design of the pump, with the general aim of obtaining the lowest possible cost.

For larger pumps of this type, particularly those for special service such as sewage pumps, there is a demand for pumps of both rotations. A design having both a separate suction head and a separate stuffing box head permits utilizing the same casing for either rotation, if the flanges on the two sides are made identical. Furthermore, for this latter group, there is a demand for vertical shaft pumps which can best be disassembled by removing the rotor and bearing assembly from the top of the casing. In many horizontal applications of the pumps of the same line, the installation favors partial dismantling from the suction side. Thus, such lines are most adaptable if made with both separate suction covers and stuffing box covers.

Casing Construction for Open Impeller Pumps

In the inexpensive type of open impeller pump, the impeller rotates within close clearance of the pump casing proper, as in Fig. 4. When the service for which the pump is intended is severe, a side plate is mounted within the casing to provide a renewable close clearance guide to the water flowing through the open impeller. One of the advantages derived from the use of side plates is that abrasion-resistant material, such as stainless steel, may be used for the impeller and side plate while the casting itself may be made of a less costly material.

While double-suction open-impeller type pumps seldom are used at present, they frequently were used in the past and generally were constructed with side plates.

Pre-Rotation and Stop-Pieces

Under certain improper entrance conditions, or when the shape of the suction approaches are incorrect, the liquid column in the suction pipe may spiral for some distance ahead of the actual entrance into the impeller proper. This phenomenon is called "pre-rotation." The occurrence of the phenomenon may be occasioned by many factors, and may exist either in vertical or horizontal pumps.

Pre-rotation usually is harmful to the proper operation of the centrifugal pump because it causes the liquid to enter between the impeller vanes at an angle other than that allowed for by the designer in his calculations. Frequently this results in a lowering of the net effective suction head and of the pump efficiency. Various means are used to avoid this phenomenon, either in the construction of the pump itself or in the design of the pump approaches.

Practically all horizontal single-stage double-suction pumps and most multi-stage pumps are provided with a suction volute, the function of which is to guide the water in a streamline flow to the eye of the impeller. With the flow coming to the eye basically at right angles to the shaft, the flow is directed to both sides of the shaft but not in equal proportions. The suction water-ways reduce in area and meet in a projecting section of the side wall dividing the two sections. This dividing projection is called a stop piece.

Nozzle Locations

To prevent pre-rotation in end suction types of pumps, a radial fin stop piece—projecting partly in toward the center from the suction nozzle wall—may be incorporated in the design.

The discharge nozzle of end-suction single-stage horizontal

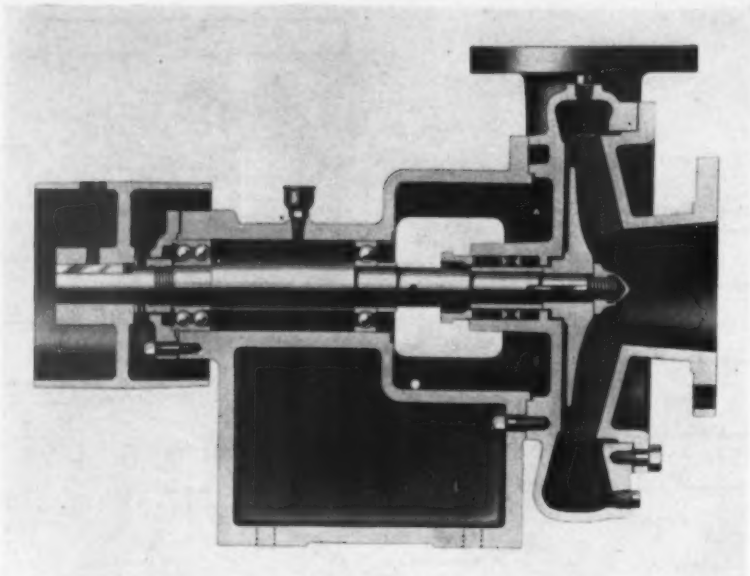


Fig. 4—SECTIONAL view of inexpensive type of open-impeller pump in which suction cover and casing serve as side walls.

shaft pumps generally is in a top vertical position (as in Figs. 3 and 4), although other nozzle positions may be obtained in certain cases, such as top horizontal, bottom horizontal or bottom vertical discharge. Fig. 5 illustrates the flexibility which can be imparted to such a pump with regard to discharge nozzle location. Sometimes the pump frame, bearing bracket, or baseplate will interfere with the discharge flange—prohibiting a bottom horizontal or bottom vertical discharge nozzle position in case of horizontal shaft pumps. In certain other cases, solid casings cannot be rotated for various nozzle positions because the seal connection on the stuffing box would be made inaccessible.

Practically all double-suction axially (horizontally) split casing types of pumps have a side-discharge nozzle and either a side or a bottom-suction nozzle. When the suction nozzle is placed on the side of the pump casing, with its axial centerline at right angles to the vertical centerline of the pump as in Fig. 2, the pump is classified as a side suction pump. When its suction nozzle points vertically downwards, the pump is termed a bottom suction pump. Single stage bottom suction pumps rarely are made in sizes below 10-in. discharge nozzle diameter.

Special nozzle positions sometimes can be provided for double suction axially split casing pumps in order to meet special piping arrangements as, for instance, a vertically split casing with bottom suction and top discharge in one half of the casing. Such special designs generally are costly and should be avoided.

Centrifugal Pump Rotation

As suction and discharge nozzle locations are intimately connected with the rotation selected for a given centrifugal pump, it is very important to understand the means used to define the direction of rotation.

According to Hydraulic Institute Standards, rotation is clockwise or counter-clockwise when looking at the driven end of a horizontal pump or down on a vertical pump. Some manufacturers still designate rotation of a horizontal pump looking at its outboard end. Therefore, to avoid misunderstanding, clockwise or counter-clockwise rotation should always be qualified by defining the direction from which one looks at the pump.

"Inboard" and "outboard" ends are terms used with horizontal types of centrifugal pumps only. The inboard end is that closest to the driver, while the outboard end is that farthest away. In the case of dual driven pumps, the terms lose their significance and are not used.

Except for end suction pumps, having integral heads on either side when separate casing patterns are required, any given centrifugal pump casing pattern may be arranged for either clockwise or counter-clockwise rotation.

Casing Hand Holes

Casing hand holes are furnished primarily on pumps handling sewage and stringy materials (which are liable to become lodged on the suction vane edges of the impeller or on the tongue of the volute) to provide access for cleaning out such material without dismantling the complete pump. On the end-suction type of pump used primarily for handling liquids of this type, hand holes with access to the suction side of the impellers are provided on the suction head or in the suction elbow. Hand hole also are provided on drainage, irrigation, circulating and supply pumps when foreign matter may become lodged in the waterways. On very large pumps manholes are often provided for access to the interior both for cleaning and inspection.

Mechanical Features of Casings

The majority of single stage types of centrifugal pumps are intended for service with moderate pressures and temperatures. It is the general practice of pump manufacturers to design a special line or lines of pumps intended for high operating pressures and temperatures, rather than to render their standard line unduly expensive by making it suitable for a wide range of operating conditions.

When axially split casings are subjected to high pressure, there is a tendency to "breathe" at the split joint. The tendency leads to misalignment of the rotor and—which is even worse—to leakage. For such conditions, internal and external ribbing is applied to casings at points subject to the greater stresses. In addition, while the majority of all pumps are supported by feet at the bottom of the casing, high temperature conditions require centerline support, so that as the pump becomes heated, expansion will not cause misalignment.

Series Units

When large capacity, medium high head service conditions require it, two single stage double suction pumps may be connected in series on one baseplate having a single driver. Such an arrangement is very common in waterworks applications for pumping against heads of 250 to 400 feet. One type of series arrangement uses a double extended shaft motor

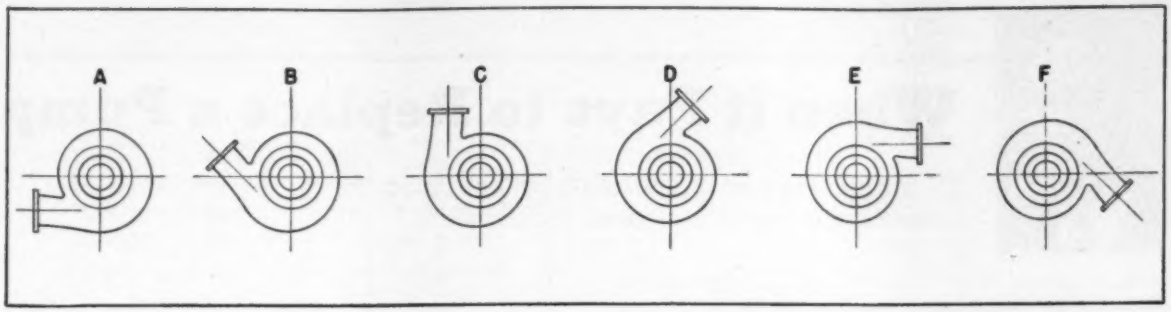


Fig. 5—POSITIONS of discharge nozzle possible for a specific design of an end-suction solid-casing horizontal-shaft pump. Rotation illustrated is clockwise from suction end.

in the middle, driving two pumps connected in series with interconnecting piping.

In a second type, a standard motor is used and one pump is then furnished with a double extended shaft. The limiting factor of this latter arrangement is that the shaft of the pump next to the motor must be strong enough to transmit the total horsepower of the unit. When the total pressure generated by such a series unit is relatively high, the casing of the second pump of the unit may require ribbing.

Multistage Pump Casings

The heads encountered in water work fields usually are relatively low, most being below 200 feet, and rarely exceeding 400 feet. In sewage pumping applications, the pumping heads usually are low—with few cases exceeding 100 feet. As a result, most water works applications utilize single stage pumps, series units, and (in case of smaller capacity higher head units) two-stage single-casing volute pumps; while most sewage applications involve single stage volute pumps.

In other fields there is considerable application of multi-stage pumps for high heads. One such field is that of boiler feed pumps where pumps develop pressures up to 1500 to 2500 psi, handling high temperature water—sometimes over 350° F. For these higher head applications both volute and diffuser types of pumps are used, the latter type being particularly suited for very high pressures and temperatures.

In the multi-stage pump field there is found a wide variation in casing designs, each having certain advantages and disadvantages. No attempt to discuss casings of the multi-stage stage pumps will be made here.

Maintenance of Casings

Pumps handling treated water in water works applications usually are not particularly subject to casing wear, so maintenance is of no specific importance. Most applications involve a high load factor, and loss in efficiency is undesirable. In maintenance of such units it is desirable, therefore, that the casing waterways be kept clear of rust and that a surface as smooth as possible be maintained. Whenever such a unit is down for repair or inspection, the waterways of the casing should be cleaned and painted with a suitable paint which will adhere firmly to the metal in order that the water velocity will not wash or jet the paint off. To give best results, efficiency-wise, an enamel-like finish is desirable. Based on local experience, a routine program of cleaning and re-painting the casing should be followed so the protective coat never will be fully eroded before replacement, otherwise corrosion may result.

When Water Contains Grit

Pumps handling gritty or sandy water naturally are more subject to casing troubles. Erosion or wear can be lessened by originally selecting pumps providing low water velocities, having the casings made of a fine grain metal. Generally, the use of a 1 to 2 per cent nickel cast iron gives sufficient added resistance, but with a high concentration of sand even a more resistant (and more expensive) material for the casing might be warranted.

In the last few years progress has been made in processes of rubber coating the waterways of pumps, and in some water and sewage works installation this coating may be found desirable. In pumping sandy or gritty water, if the casing is to be protected primarily by periodic painting, care should be taken to select a type of paint suitable for the local conditions and to establish a schedule of maintenance to suit.

Eroded or Pitted Casing

Occasionally because of the erosion properties of sand in the water, or because of neglect, a casing will become eroded or pitted. Naturally any eroded or corroded areas should be filled and the entire waterways then painted. The method used in building up the eroded or corroded areas will depend upon the material of the casing and the location of the damaged area. For example, a corroded area located where the water velocity is low, could be filled with concrete if properly anchored. Such a repair would not be suitable to correct an eroded portion; it would be necessary to build up an eroded area by brazing, welding, or other means suitable for the material of the casing and the service.

W&SW

Manitowoc, Wis., to Combine Water and Sewage Utilities

Operation and maintenance of the sewerage system and treatment plant of Manitowoc, Wis., is presently under the local Board of Public Works. Incident to treatment plant enlargement to provide secondary treatment, it is proposed by the City Council to transfer the sewerage facilities to the Public Utilities Commission of Manitowoc, thereby combining the water and sewage utilities under one management.

This comprises another case of municipalities going to joint operation of water and sewage works as a general trend toward economy, improved efficiency and lessened political influence in the operation of these two important utility services.

When it Pays to Replace a Pump

. . . when the cost of operating an old pump exceeds the cost of a modern replacement.

by C. E. CROMWELL, *De Laval Steam Turbine Co., Trenton, N. J.*

DIGGING into the economics of operating an old pump frequently turns up highly profitable information. Often what appears to be "satisfactory performance" may be actually blinding us to the real costs. Reducing day in and day out operating costs can very well effect savings more than sufficient to finance a modern pump and also produce savings even beyond the important power cost reduction.

A pump may still be delivering designed capacity and head despite its age. It is this fact, the seemingly satisfactory performance of the pump, that protects from closer scrutiny its reputation as an "old faithful." Gradual decreasing efficiency is not always noticeable. Nor, are power costs looked upon as excessive unless totaled up over a span of years and compared with the overall expense of investing in a new pump. Pump manufacturers have in recent years come a long way in designing more efficient units to reduce overall operating costs.

Consider the Last Quarter Century of Progress

Consider a motor driven pump built in 1928 to handle 2,500 gpm against 150′ total head. When originally built, it had an efficiency of 78% requiring an input of 121 bhp. Due to wear and tear, and if no revolving parts have been replaced, it could be expected that the pump in 1953 would have an efficiency of about 74%, and would require 128 bhp to deliver the designed capacity and head. Note the moderate 4% loss in efficiency—apparently nothing to get excited about.

A modern 1954 pump for these same conditions could be expected to have an initial efficiency of 86%, requiring 110 bhp. This 12% efficiency difference represents a possible saving of 18 bhp. Based on a power cost of 1c per kwh, savings in power cost for one year (8760 operating hours) is $1176.00.

Application of the $1176 Annual Savings to Financing a New Pump

The cost of a new pump or complete unit, and the time it would take to pay for it from the operating-savings gained over old existing pump are shown here. The following figures are based on 1c per kwh, or $.00746 per hp. (Additional costs for freightage and for changing foundation and piping must, of course, be included in arriving at the total cost figure.)

New Pump Unit Costs

Price (estimated) of new pump, base, coupling	$1238
Price (estimated) of 125-hp 440-v 1750-rpm motor	1390
Price (estimated) of reduced voltage starter	1170
Total cost of new pump, motor, starter	$3798

	Hours of Operation per Year		
	8760*	6500	4000
Savings will pay for pump, base and coupling in	13 mos.	17 mos.	28 mos.
Savings will pay for complete unit in	39 mos.	52 mos.	84 mos.

* Continuous operation of single unit.

Even if renewal parts for the 1928 pump could restore its original efficiency of 78%, it still requires 11 hp more than the new pump. Based on 8760-hr. operation per year, power cost of old unit is still $719 more. Depending on how out of date the pump parts are, they might be relatively expensive, compared with the cost of a modern pump.

A Surprise to Some: Perhaps to Many

If the amount saved each year on power cost were set aside to accumulate interest, the total will then represent an amount that will pay for all or part of the cost of a new unit. If the pump owner's practice is to consider relatively long term write-offs, these saving may well be sufficient to pay for the new unit and also for other additional capital expenditures.

A municipality figures in terms of bond issues of 15 years or more and even at presently favorable interest rates of 3% a small annual saving, based on the preceding example, soon pays for the original investment. In fact, many cases would show that by the end of a 15 year term such savings would represent the write-off of a much larger capital expenditure. Take the $1176 saved on power cost with a new pump, as shown: If, for a municipality, this amount were set aside to accumulate interest at 3% compounded annually for 15 years, it may surprise some to find that a capital investment of $21,871 could be written off.

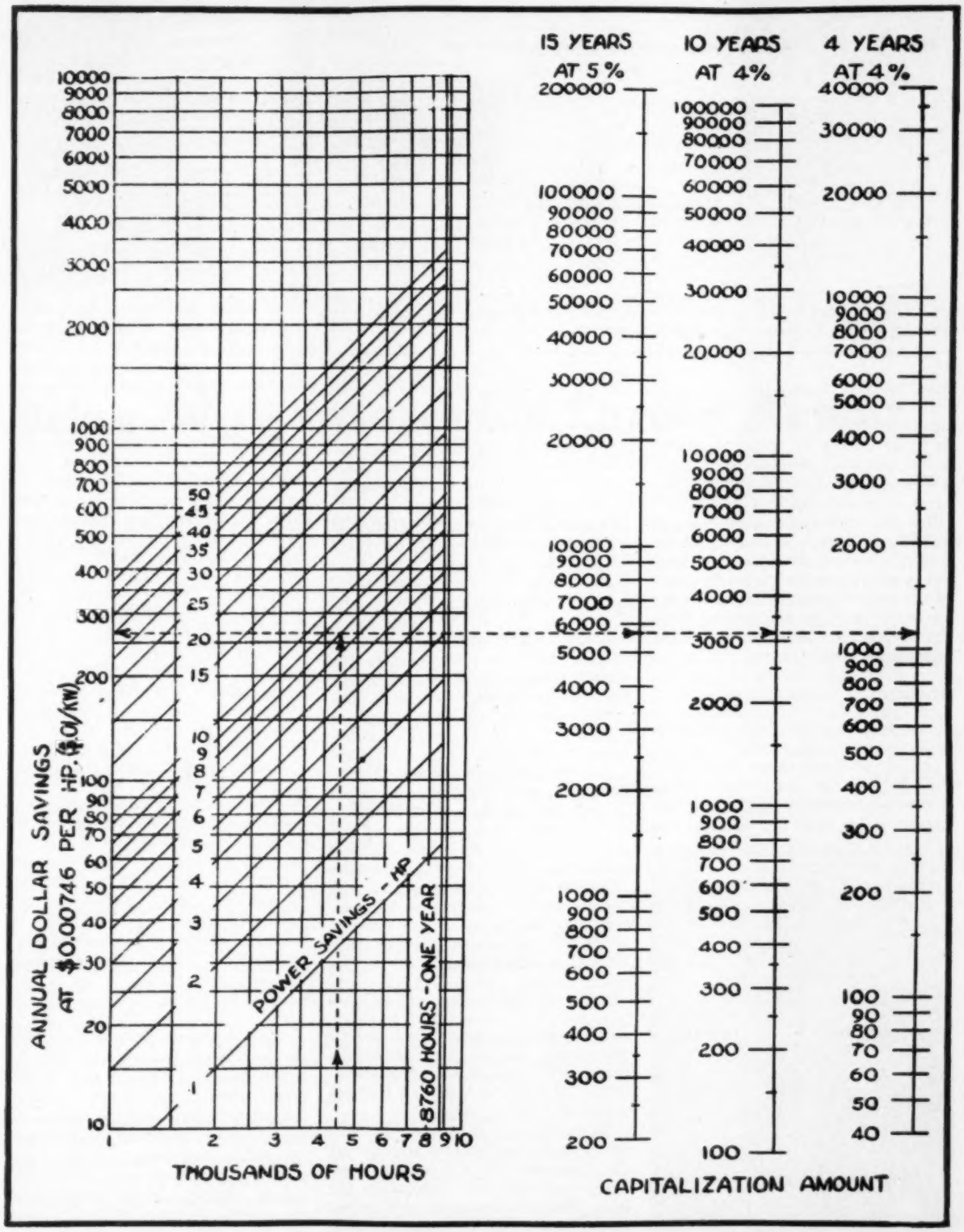
Some operators of central-station power plants believe that in a new station a unit that pays for itself in 8 to 10 years is a good investment. When replacing old equipment, the expected life of the plant may reduce the length of write-off that can be considered. This premise must be considered throughout industry, regardless of the products.

Chemical companies or oil refineries prefer to write off investments in 3 to 4 years, or possibly 2 years. A chemical company capitalizing the savings at 4% for four years could only write off an investment of $4994.00. Even so, the practice of rapid write off is followed in general.

Calculating Savings

Calculation of power cost savings and capitalization amounts can be made quickly by using the accompanying chart. First compute the horsepower savings and multiply the results by yearly hours of operation. This chart can be used for quick approximations and can be read within about 2% accuracy.

The diagonal lines represent "horsepower savings." The abcissa shows "hours per year" of operation. Reading vertically up the "hours per


15 YEARS AT 5%
10 YEARS AT 4%
4 YEARS AT 4%
ANNUAL DOLLAR SAVINGS AT $0.00746 PER HP. ($10/KW)
POWER SAVINGS - HP
8760 HOURS - ONE YEAR
THOUSANDS OF HOURS
CAPITALIZATION AMOUNT

CHART—For calculating power cost savings and capitalization amounts

Compute horsepower savings and multiply by hours per year.

Table 1*

Years	% Interest Rate/Annum, Compounded Annually				
	2	3	4	5	6
2	.49505	.49261	.49020	.48780	.48544
3	.32675	.32353	.32035	.31721	.31411
4	.24262	.23903	.23549	.23201	.22859
6	.15853	.15460	.15076	.14702	.14336
8	.11651	.11246	.10853	.10472	.10104
10	.09133	.08723	.08329	.07950	.07587
12	.07456	.07046	.06655	.06283	.05928
15	.06260	.05377	.04994	.04634	.04296

* Annual Savings divided by factors in table equals sum including interest accumulated for number of years and interest rate selected.

year" to the "horsepower savings," to the left ordinate is the "annual savings" in power cost, and to the right ordinate is the "capitalization amount." Shown are 3 right hand ordinates, each for different interest rates and terms of years.

The chart is based on cost of power at $.01 per KW. If in a particular locality power cost is more or less, simply multiply answer from the chart by the ratio to actual cost; i.e., if the cost is 12 mils per KW, multiply by 1.2; if the cost is 9 mils per KW, multiply by 0.9.

Examples

The following examples are taken from records to show what improvements in efficiency have been made and the savings and capitalization amounts are taken from the attached chart.

1. Service Water Pump. Consider a pump installed in 1926 having an efficiency of 70% and an input of 28.9 bhp. A modern pump for the same conditions (400 gpm, 200 ft. total head) has an efficiency of 79% and an input of 25.6 bhp. This is a 3.3 bhp saving. Annual saving if service water pump runs 6000 hours per year is $150. Capitalized in 4 years at 4% interest the total amount is $630. The estimated price of a new pump for these operating conditions is $438.
2. Boiler Feed Pump. 400 gpm, 650 total head at 220 F.

   year 1930, efficiency 63%, 99.5 bhp
   year 1953, efficiency 69%, 91.0 bhp
   saving of 8.5 bhp

   Annual saving if pump operated 8760 hours per year is $560. Annual savings capitalized in 10 years at 4% represents a total of $6700. Estimated cost of new pump is $1101.
3. Water Works Pump. 15 mgd (10,400 gpm), total head—200 ft.

   year 1926, efficiency 84%, 625 bhp
   year 1953, efficiency 89%, 590 bhp
   saving of 35 bhp

   Annual saving if pump operated 5000 hours per year is $1300. Annual savings capitalized in 15 years at 3%, represents a neat total of $24,177. Estimated price of new pump is only $4054.

When accurate calculations are required for formal presentation, annual savings are obtained by multiplying horsepower savings by yearly hours of operation by cost per horsepower hour. (kwh cost x 0.746). The annual savings divided by a factor, based on terms of years of interest rate will give the capitalization amount. Table I lists these factors for various terms and interest rates. These can also be used for terms other than those shown on the chart.

Undoubtedly, most plant engineers in industry and municipalities realize that the wasted costs of operating old equipment could very well represent the purchase price of new equipment. But management officials must be shown why the purchase of modern equipment is a wiser investment than the continuing costs of operating old equipment.

If power and depreciation should be negligible factors (seldom the case) there are still repair costs of some kind to consider. Obsolete parts are not only more expensive but require extended delivery time. Should production losses occur because of the delay in obtaining obsolete renewal parts, the losses are chargeable to the old pump. The cost of modern renewal parts, for which patterns are available and the parts are in stock, represent very tangible savings when compared with the cost of obsolete parts. Actually, sometimes a modern pump can be purchased at prices equal to or even less than the cost of extensive renewal parts for an old pump.

The chart and examples shown here should help engineers and managers or other officials gain a graphic insight into economics of pump depreciation, deterioration and obsolescence. They will also show how the higher operating costs entailed by these three factors could be converted into appreciable yearly savings to make modernization pay its own way.

W&SW

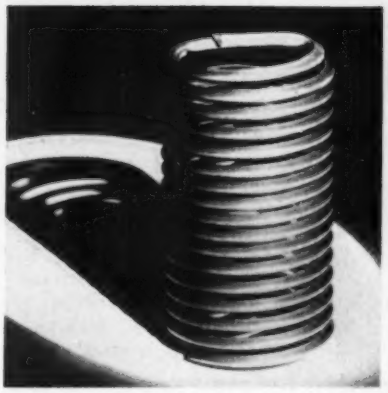
"Wally" Miller Joins Cast Iron Pipe Assn. Staff

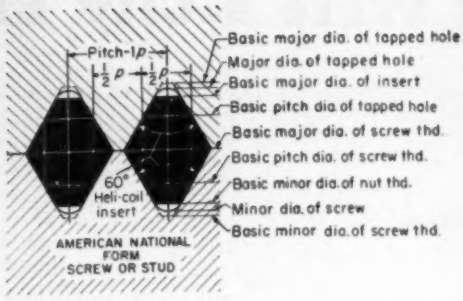
Thomas F. Wolfe, Managing Director of the Cast Iron Pipe Research Association, has announced the addition to the association staff of Wallace T. ("Wally") Miller of Rochester, New York.

During the last five years Mr. Miller has served as General Manager of the Rochester Division of the New York Water Service Corporation. He had formerly managed the water works operations at Ossining, New York for a period of 18 years.

For three years during World War II he served in the Civil Engineering Corps of the U. S. Navy, attaining the rank of Lt. Commander, being assigned to Naval Operations within the continental limits as well as the Samar Naval Station in the Philippine Islands.

"Wally" Miller has been active in the affairs of the American Water Works Association, having been chairman of the New York Section and a member of the Board of Directors of A.W.W.A. for a three-year term. He was voted the Fuller Award in 1952. Mr. Miller, a graduate of New York University, is also a member of the Rochester Engineering Society and the Theta Chi Fraternity.




Pitch-1p
1/2 p
1/2 p
60°
Heli-coil insert
AMERICAN NATIONAL FORM SCREW OR STUD
Basic major dia. of tapped hole
Major dia. of tapped hole
Basic major dia. of insert
Basic pitch dia. of tapped hole
Basic major dia. of screw thd.
Basic pitch dia. of screw thd.
Basic minor dia. of nut thd.
Minor dia. of screw
Basic minor dia. of screw thd.

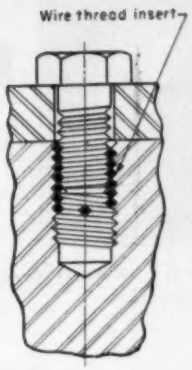


Fig. 1, 2 and 3—The HELI-COIL insert is diamond-shaped wire, conforming to standard thread specifications.

Using Wire Inserts for Thread Repair

ON-THE-SPOT repair of stripped or worn threads can mean a great saving to construction equipment operators. By using a thread repair technique which permits field service of off-the-road machinery, down time can be reduced to a minimum, no costly movement of heavy equipment is necessary and fewer men need be diverted from more productive work for the repair job.

The key to this new thread repair technique is a helically wound coil of diamond shaped stainless steel wire (Fig. 1) called the Heli-Coil screw thread insert. When used to replace a stripped or damaged thread in a hole, the insert forms a female thread the same size as, but stronger and more wear-resistant than, the original thread. This is done at no significant expenditure of wall thickness or part strength.

The technique involves simply drilling out the old threads, retapping the hole and turning in the insert. A portable air drill or electric drill will do the job because the old hole will serve as a guide. Both the tapping operation and the inserting operation can be done by hand. The technique does not require heat, such as a welding operation, which presents a fire hazard. It often can be accomplished without removing the outer section of a housing or otherwise dismantling the equipment.

The insert is made from wire that has been rolled to a diamond-shaped cross-section with two 60-degree points (Fig. 2). The insert is coiled in such a way that these 60-degree angles become internal and external threads. When installed, the outer thread seats firmly in the retapped hole, and the inner thread provides a perfect fit for the original size screw (Fig. 3).

Receiving threads in the tapped hole are produced by a Heli-Coil tap, which cuts to the proper diameter to accommodate the wire. This is so slightly oversize that repairs can be made close to edges, water jackets, etc., without danger of break-through.

The insert strengthens the thread because it is flexible. When a screw is tightened into it, the insert adjusts itself until all threads are carrying an equal share of the load. Because of its hardness and smoothness, the insert has greater wear resistance than ground or tapped threads and will permit frequent screw removal without wearing out.

United Engineers & Constructors, Inc. of Philadelphia, Pa. have used the wire thread inserts to save on maintenance costs at the Shepaug Hydroelectric Development, a hydroelectric dam the firm is building on the Housatonic River for The Connecticut Light and Power Company. They have learned to recognize the symptoms of thread wear and to correct the condition before serious damage and possible personnel injury has occurred. Threads that hold screws become worn and permit bell housings of power take-offs to work loose. Wire thread inserts have been used in the repairs of truck cranes, tractor roller track frame and a pump valve case.

Fig. 4 illustrates retapping prior to using a wire insert for a truck crane on which a mounting screw that holds the outrigger support has become loose. Because of the extremely heavy stress concentrated on these screws when the crane is "working over the side", the threads tapped in the based plate must be kept in top-notch condition. The mechanic is shown drilling out the old thread, tapping the redrilled hole and installing the insert. By using the inserts, maintenance men can keep pieces in excellent condition at a minimum of effort and lost time.

W&SW

Fig. 4—STRIPPED THREADS are drilled, hole is tapped, and insert repairs the job.

If I Were a City Engineer...

A Mayor's advice on how best to serve one's city

by J. P. LAWLOR, *Mayor, City of Ames, Ames, Iowa*

Mayor Lawlor here makes a strong plea for civic mindedness on the part of public works officials. His paper, originally titled "What the City Engineer may do to Improve his City", was recently presented to the Fifth Annual Conference of City Engineers and Public Works Officials at Ames, Iowa.

—the Editors

THE City Engineer may make many contributions toward the improvement of his city. I have chosen to emphasize two objectives which, to me, seem of primary importance.

If I were a City Engineer, I would strive:
First, To be a better engineer, and
Second, To become thoroughly civic minded.

Broad Knowledge Needed

One of my professors in Civil Engineering had a stock question he asked every engineering class. It ran something like this. "What is the most important hour in the day of every engineer?" His answer was "Around 6 o'clock in the evening." He maintained that during that hour a man usually made one of the most important decisions of his life and that decision was, "Shall I spend an hour this evening studying something to improve myself as an engineer?"

The professor would point out that an average of just one hour of study for six nights a week would mean over 300 hours per year; and that even the poorest engineer was certain to gain much information by following such a routine of study.

The City Engineer requires a broader knowledge of more subjects than is required by an engineer in any other field. The principal subjects with which a City Engineer should be familiar are:

Water supply
Transportation
Communications
Sanitation
Light and power
Finance
Machinery and equipment
Public relations
Law

To achieve the second important objective, that is, to become thoroughly civic minded, the City Engineer should:

Take an active part in civic affairs.
Talk engineering projects in the layman's language.
Exercise leadership.
Engage in advance planning.

Now let's review each of these requirements in greater detail.

To Be a Better Engineer

The most important requirement of a city is water. Every city must have a water supply and the amount required is constantly increasing. A few years ago, we considered 60 gal. per capita per day as a conservative figure. Now we talk in terms of 150 to 200 gal. per capita per day, including normal industrial requirements. This amount of water certainly doesn't come from rain that is collected in a cistern, so it must be found in streams, lakes, impounded reservoirs or wells. In selecting the source, careful consideration must be given to the amount of water that will be available from that source in the years to come. Therefore, the engineer must have good information regarding the development of an adequate water supply for his city.

Water Supply Problems

If the source of water is a surface supply, the water must be treated. An underground supply may be satisfactory from the standpoint of sanitation, but such water generally contains too much iron, dissolved gases or minerals to be used without treatment. Therefore, the City Engineer must have some knowledge of what treatment will be required before the water is pumped into the mains for delivery to customers. He must have some idea what this treatment will cost, and exercise judgment as to the selection of the most satisfactory treatment that will result in the greatest over-all savings to the community.

Another problem is involved in distributing the water to the customers. Distribution is related to the daily and hourly pumpage, thus decisions must be made as to the amount of water that should be treated and stored to meet peak demands, and where storage reservoirs should be placed.

The subject of fire protection is closely related to pipelines and storage reservoirs. Fire risks and the cost of insurance to the community must be considered.

The cost of pumping water through the mains under satisfactory pressure requires study of pumping machinery. Pumps high in efficiency must be selected so as to keep power requirements to a minimum. The mechanical design of the pumps, and the materials of construction, must be such as to keep down costs of repair and maintenance.

Transportation Problems

The people of the community must have transportation in order to move from place to place safely and rapidly. Therefore, the city engineer needs a thorough knowledge of streets, roads, curbs, gutters and sidewalks. He must provide preliminary plans for proper grades and elevation for streets, sidewalks and curbs and gutters. It is not necessary to be an expert bridge engineer, but a good understanding of bridge construction often comes in handy.

Another problem relating to transportation is proper drainage. A knowledge of run-offs, dangers from flash floods, size, grade and location of storm sewers is required.

These are transportation items that people use every day without thinking of the difficulties in putting them there. The only time the public notices any of these transportation features is when inconveniences develop, such as a hole in the street or sidewalk, a bad grade, a flooded area or a bad intersection. The engineer must have a thorough knowledge of the materials required to construct and maintain every one of these projects.

PUBLIC CONVENIENCE

"In most of his jobs the City Engineer is concerned wtih doing something for the convenience of the public."

When a city has an airfield, it is necessary that the City Engineer know something about the design of runways, and that he cooperate with the CAA in establishing features such as direction of runways, proper grades, proper drainage, type of runway surfacing and a number of precautions involving safety.

Communications Problems

Communications play a highly important part in modern life. Without the aid of telephone, radio, telegraph, post office and good streets, a community cannot remain active. While modes of communication generally are not a responsibility of the City Engineer, he will become involved in such items as rights of way for high lines and cables for telepone and telegraph companies. These lines must be placed as not to inconvenience the public.

This is a good time to emphasize the fact that *in most of his jobs the City Engineer is concerned with doing something for the convenience of the public.*

Sanitation

In respect to public convenience, the problem of sanitation is a classic example. Basically, the practice of sanitation includes the destruction or removal of all things that might endanger public health or that might be offensive to the senses of sight or smell. As you know, it often is difficult for the public to adjust itself to the idea of spending money for sanitation or, putting it another way, spending money to get rid of something that has no value.

Sanitation problems might generally be divided into three principal classes, namely, the disposal of sewage, the disposal of refuse, and drainage to eliminate stagnant pools of water.

In connection with sewage disposal, the City Engineer must certainly utilize his basic college training in the design and layout of grades, and sizes of sewer lines, and in establishing grades and depths for trunk lines. Long range planning must be done. The design of a complete sewage treatment plant generally is the problem of a professional consulting engineer; nevertheless, the local engineer must have an appreciation of the problems involved and give every possible local aid.

No longer do we let refuse pile up in backyards or in open ditches. Garbage must be eliminated by incineration or by covering. This brings the engineer into the field of contour maps and of earth moving equipment.

Power and Light Problems

The principal functions of the electric power utility can be divided into two parts, namely, generation of electricity, and distribution of electricity.

If I were a City Engineer for a municipality that owned its power plant, I would be involved in electrical problems, especially the one of generating power. The design and construction of power plants is definitely the responsibility of consulting engineers specializing in this field. Some important contributions in connection with general plant layout and equipment selection can be made by the local engineer. If the power is furnished by a privately owned plant, there will be no problems in the generation of electricity.

Power distribution, the location of high lines and transformer stations have a bearing on the safety and convenience of the citizens, and the engineer on the site must be prepared to offer helpful suggestions regarding rights of way for high lines, cables and transformers. Although the operation of a municipally owned power plant generally is not a direct responsibility of a City Engineer, his services are helpful in the field of maintenance and

BROAD KNOWLEDGE

"The City Engineer requires a broader knowledge of more subjects than is required by an engineer in any other field."

operation of such plants. Electricity plays a highly important part in the daily life of all citizens; therefore, since it is a public utility, it is the responsibility of the City Engineer to be familiar with the capacity both of the electric generating and the distribution systems, regardless of ownership.

Finance

A City Engineer is not ordinarily expected to assume the responsibility of supervising bond issues for raising funds to finance the various public utilities. However, he must be qualified to prepare cost estimates on routine projects and to understand and check cost estimates prepared by professional engineering firm employed by the City for the design of larger projects. Also, it is important to have an understanding of the various methods of raising funds, such as general obligation bonds, revenue bonds, property assessments, equitable distribution of property assessments, municipal warrants and miscellaneous tax assessments related to public util-

ities. A knowledge of these factors will make it much easier to work in harmony with other City officials.

Machinery and Equipment

The City generally will own various types of utility equipment, such as automobiles, trucks, street cleaning equipment, pumping machinery, motors, graders and power generators. Although it will not be expected that he be an authority on the design of all this machinery, the City Engineer often will be called upon to be of service in connection with the operation, maintenance and the purchase of such equipment. The matter of depreciation will be of interest to him. His advice can be helpful to the City in spending its money for equipment that will be most suitable for the particular task to which it is to be assigned.

PUBLIC RELATIONS

"It is the duty of the City Engineer to help citizens understand more about public utilities through the medium of public relations."

Public Relations

Practically everything about a public utility is built around service—service to the public. People generally are quick to criticize the type of service they receive, particularly if it is slightly below par. A part of the criticism stems from the fact that the individual making the complaint does not appreciate all the circumstances. It is the duty of the City Engineer to help citizens understand more about public utilities through the medium of public relations. People are not always wrong in their criticism, and it is his duty to try to understand a citizen's point of view. In rendering public service, care should be taken to show no discrimination.

Law Is Involved

I would consider it very unwise for the City Engineer to give legal advice; nevertheless, it is necessary that he understand reasonably all laws relating to our public utilities, both State statutes and local Ordinances. When there are laws that he could not understand, he should seek correct interpretation from the legal profession. City Ordinances ofter require revision, and he should be prepared to take part in revision of such portions of Ordinances that relate to the public utilities.

Records Are Important

The City Engineer's office is a place of records. These records include maps of the entire City, maps of additions and subdivisions, boundary lines of every piece of property in the City, the exact location of all pipelines for sewer and water and connections thereto, location and connections for high lines, elevation of all sidewalks, curbs, gutters, sewers and pipelines, location of fire hydrants, plans and specifications on all buildings and on all equipment and machinery owned by the City. All of these records must be carefully classified and properly filed. Whenever the City employs outside consulting service for a special project, each report, plan and specification, bid and other data relating to every project, should be properly filed in the City Engineer's office. These papers generally represent a considerable investment on the part of the City and should be carefully preserved for future reference.

Become Civic Minded

Every modern American city has a number of organizations that play an important part in the development of the community. Generally, these organizations are State, National or International in nature but most of their City activities are at the local level. The most important of all of these organizations is the Spiritual, the organization that teaches the principles of Christianity throughout life.

Local Organizations

A sincerely Christian community would not be loaded down with perplexing situations, because such situations are bred from graft, dishonesty, selfishness, or a general tendency to disregard the principles of the Golden Rule. The writer considers it good common sense to belong to, and be active in a spiritual organization that is constantly advocating spiritual values.

Membership of the City Engineer in a good Service Club, such as Lions, Rotary or Kiwanis, and the local Chamber of Commerce is very desirable. The basic purposes of such organizations are to create a better understanding and a friendlier understanding and a friendlier feeling between men, and to do good for the community. As an active member in any of them, one can certainly help to improve his City.

To insure that my city would continue to improve, I would be very much interested in what the *future citizens* are learning. I would attend, and take active part in, meetings of the PTA and the School Board. I would want to know a great deal about the teachers who are teaching these children the conventional "three R's", plus an R for "Reasoning."

CIVIC LEADERSHIP

"When called upon to take charge of a civic project, the City Engineer should tackle the job willingly and seriously."

Youth organizations such as the Cubs, Brownies and Scouts are worthy of support because they do much to develop character and understanding regardless of race, color or creed. Physical development of youth, through athletics, is highly important. There is a need for football fields, basketball courts, swimming pools and tennis courts.

Above all, I would constantly advocate, and support, the election of City officials who are honest and capable. It is considered improper for a City employee to engage in politics. If two equally well-qualified men are running for the same office, it is definitely bad taste for a City employee to work for the election of either. However, if two men are running for the same office and one has a good reputation and the other does not, I would, as a taxpayer, be so bold as to go out and fight for the good one at the risk of sacrificing my position if he lost.

Talk Engineering Projects in Layman's Language

There is nothing more down to earth and truly common sense than sound engineering. I would be sure to find many common sense individuals in my community who are not engineers. They could be of help to me if some of our engineering and utility problems were explained in layman's language. The better these people understand the problems, the more they will appreciate what is being done, and will lend their support to ideas concerning how their city can be improved.

Leadership Ability

I would try to cultivate leadership ability and to apply it within my capabilities. One way in which this can be done is by speaking in public meetings. When called upon to take charge of a civic project, the City Engineer should tackle the job willingly and seriously.

Leadership is exercised by thoughtfully dividing responsibilities among those who are to help, carefully explaining all objectives, holding meetings, setting deadline dates, calling for reports and seeing to it that everyone carries his or her fair share of the load. It is impossible to define the art of leadership in a few words, but I do know that civic welfare is promoted by exercising capable leadership whenever a request is made to assume responsibilities of a civic or engineering nature.

Where are the most desirable residential developments going to take place? Where is the logical place for industrial developments? What can we do to avoid the growth of slums? After these fundamental questions are settled comes the development of streets, water supply, sewage disposal and other engineering projects under the classification of utilities.

Advance Planning

Advance planning in the growth and development of a city is a subject in which I would be interested as a City Engineer. This subject has been placed under "Civic Mindedness" rather than under the classification of "Good Engineering." Advance planning might rightfully be placed under either classification. However, it includes many subjects other than engineering.

The proper zoning of certain areas—residential, business and industrial developments—requires careful study by businessmen, engineers and other professional people. I would consider it the duty of the City Engineer to emphasize the engineering aspects of all subjects that come under discussion with relation to advance planning for the growth and development of the city.

Conclusion

"What the City Engineer may do to improve his city" has been discussed under two classifications: Be a better engineer, and be civic minded.

If I could do a good job in all the tasks outlined under these classifications, I feel certain that I would be a happy and well-rewarded engineer.

W&SW

Osawatomie, Kansas, 1,000th U. S. City to Adopt Water Fluoridation

Participants in the Start of Fluoridation at Osawatomie

The one-thousandth municipality to institute fluoride treatment of its water supply was Osawatomie, Kansas, which made of this step toward the preservation of children's teeth a special event. The presidents of the Am. Dental Assn., and the Am. Water Works Assn., participated in the ceremonies attended by 1500 persons. Also present were other national figures such as Dr. John Knutson, chief dental officer of the U. S. Public Health Service who represented Mrs. Oveta Culp Hobby, Secretary of Health. A congratulatory telegram, explaining her inability to attend, was received from Mrs. Hobby.

Under leadership of the Junior Chamber of Commerce the proposal to fluoridate Osawatomie's water supply was adopted by popular vote of the people. This, commented Sec'y Hobby, "was in the best American tradition."

Dale Maffitt, president of the Am. Water Works Assn., stated that this national body did not promote fluoridation, but stood willing to aid any city in which the people had shown a pronounced desire to adopt water fluoridation for its anticipated benefits to the community.

Participants in the ceremonies, as shown in the photograph, are: from the left: Mayor L. E. Teeter; Dale Maffitt (Des Moines, Ia.), president of the Am. Water Works Assn.; Dr. John Knutson (Washington, D. C.), chief dental officer of The U. S. Public Health Service; Dr. L. M. Fitzgerald (Dubuque, Ia.), president of the Am. Dental Assn.; Dr. V. W. Harville (Osawatomie), chairman of the Flouridation Committee of the Junior Chamber of Commerce which promoted fluoride treatment; Dr. James Sherry (Kansas City), president of the Kansas Dental Society.

GOOD PLANNING is evident in this installation of chlorine feeders

Principles of Chlorine Gas Feeders

With special reference to applications of chlorine in the treatment of industrial waste

by R. W. PEARCE

CHLORINATION as a unit process in waste treatment requires a chlorine feeding device. The process may also require supplementary equipment, including:

Flow Measurement, Mixing (rapid), Operation Control, pH Control, Proportional Pacing, Pumping, and Tanks.

The chlorine gas feeder is the heart of the treatment process and its principles of operation are important to a thorough understanding of its use and control. Construction and operation of the chlorine feeder is dictated, largely, by the properties of chlorine (See Table 1.).

Mr. Pearce is manager of Chlorinizer Sales, Builders-Providence, Inc., Div. of B-I-F Industries, Inc., Providence, R. I.

His paper was presented at the Ninth Industrial Waste Conference at Purdue University, under the title, "Chlorine Gas Feeders" and has been revised for publication in "Water & Sewage Works."

Handling Chlorine

Cool, dry chlorine gas is inert in its action on metals. Dry chlorine gas or liquid under pressure may be handled safely in pipes of extra heavy black iron, wrought iron, or steel, and in copper tubing, or other materials which will withstand high pressure. Flexible copper tubing connections are commonly used to convey chlorine from cylinders to feeders. Dry chlorine gas under low pressure or vacuum may be conveyed in the same materials as high pressure gas; also in hard rubber, Uscolite, polyethylene and several other plastic materials.

Slightly moist chlorine is extremely corrosive. When moisture is present, chlorine may be handled only in rubber, hard rubber, plastic and other similar materials at low pressures. For high pressure conduction of wet chlorine gas, a few metals such as silver, platinum, lead and Hastelloy "C" may be used, but, while resistant to the action of wet chlorine, they will eventually deteriorate. The me-

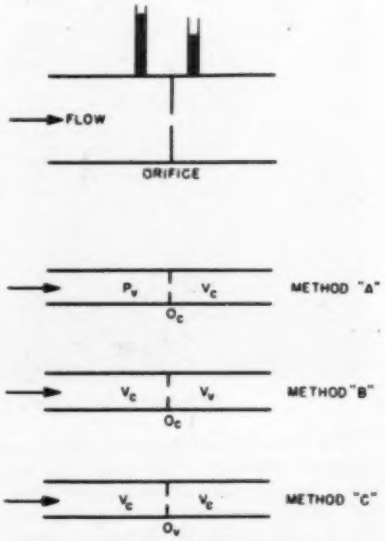


Fig. 1—BASIC PRINCIPLES involved in chlorine feeder design

tallic element, tantalum, is completely inert to the action of chlorine gas, wet or dry, but it is too expensive as a substitute for other metals in general use. It is used, however, in some chlorine gas feeder parts. Chlorine gas dissolved in water in highly concentrated solution is acidic; it must be handled only in hard rubber, rubber-lined or Saran-lined piping, rubber-lined hose, polyethylene hose or Uscolite piping.

Dissolving Chlorine

Chlorine has a low solubility. At 68°F, approximately 17 gal. of water are required to dissolve one pound of chlorine. It is difficult to introduce chlorine gas directly into a line or open channel. Under such application conditions, special provision must be made for dispersion of the gas. A closed system must be under pressure; in an open system there must be a depth of 10 to 12 ft. of liquid over the diffuser. In the closed system there is danger of undissolved chlorine gas pocketing at the top of the pipe and causing corrosion. In an open system, undissolved chlorine gas may escape from the surface of the water. In either case, there is a possibility of chlorine hydrate forming, when the water temperature drops below 50°F, with the result that diffusers and injectors may become clogged.

The preferred method for delivering chlorine is to dissolve the gas in a minimum amount of water so that a relatively stable, but high strength, solution may be applied when desired. This is the common practice. The feeder, which controls the flow of chlorine gas, meters it and puts it into solution, is commonly referred to as a solution type chlorine feeder.

Withdrawing Gas from Containers

To withdraw chlorine gas from a cylinder, it is necessary to supply sufficient heat units to satisfy the latent heat of vaporization of chlorine. The required heat must be transferred from the surrounding atmosphere through the wall of the container and the liquid within. Because of the limited rate at which the heat can be absorbed by the liquid, there is a limited rate at which chlorine may be discharged from cylinders or containers.

In a room at approximately 70°F, with cylinders or containers located so that there is free circulation of air around them, a 100 or 150 lb. cylinder will continuously deliver approximately 40 lb. of chlorine per day and a ton container will deliver approximately 450 lb. a day without excessive cooling. If rates of withdrawal are higher than these values, excessive cooling will occur and frost will build up on the outside of the container. When the desired rate of feed is above that which can be obtained from a single cylinder or container, then two or more containers may be installed parallel and connected to a manifold so that each container delivers part of the load.

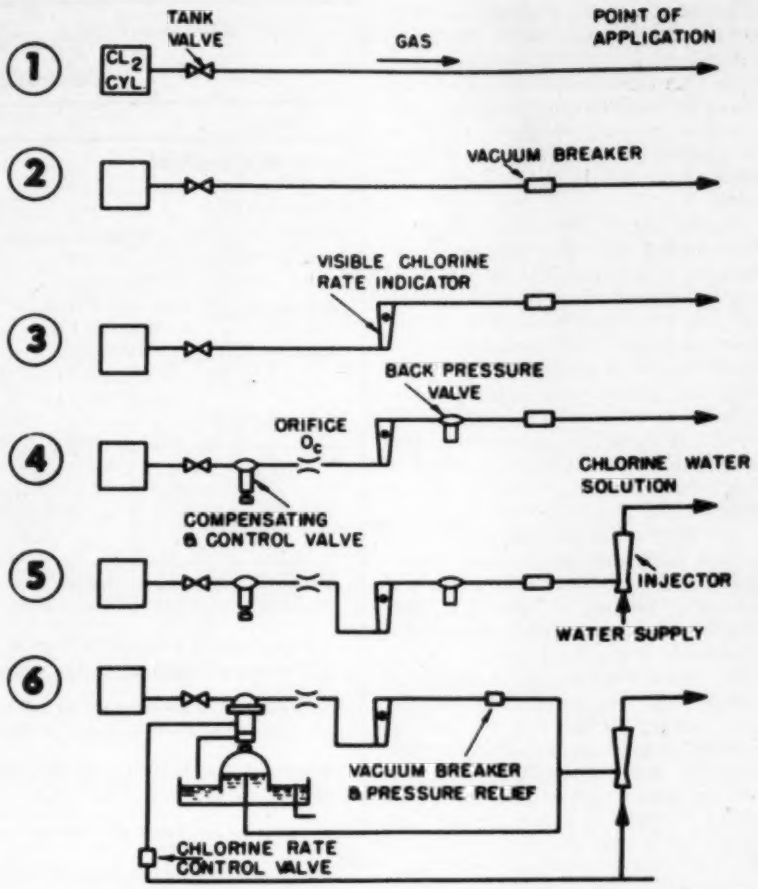


Fig. 2—EVOLUTION of chlorine feeder design as improvements were added

Types of Feeders

Chlorine gas feeders may be classified into four types:

Direct-Feed Type—Chlorine gas under pressure is delivered directly to the point of application. (This system is sometimes referred to as dry feed.)

Solution Type—Chlorine gas is dissolved with a minimum amount of water in an injector or eductor and delivered in solution to the point of application.

Semi-Vacuum Type—Solution type feeder in which the system is maintained under vacuum during the time the eductor is in operation. If the vacuum fails, chlorine gas will continue to flow through the system, as there is no automatic shut-off on loss of vacuum.

Full Vacuum Type—Solution type feeder in which chlorine gas is maintained under vacuum throughout the apparatus. An ejector is employed into which the gas is drawn to provide solution feed and create the vacuum. In this feeder, the vacuum governs the operation of the chlorine inlet valve directly or indirectly so that the chlorine will not feed unless sufficient vacuum is induced through the apparatus. This type of feeder is most common, because safe operation is assured. It employs a direct indicating meter and the flow of chlorine is automatically shut off on loss of vacuum, stoppage of discharge line, or loss of operating water pressure.

How the Feeder Operates

Basically, a chlorine gas feeder is a simple apparatus. It operates on the principle of regulating flow by controlling conditions existing upstream and downstream of an orifice in a flow line. This orifice may be constant or variable. Various additional

refinements are incorporated in the modern chlorine gas feeder, but these refinements do not alter the basic principle. The refinements are present to assure low maintenance, long life, and to afford greatest possible protection to operating personnel and to the premises in which the feeder is located.

At the top of Fig. 1 is a diagram representing the flow of any fluid through a pipe line. The rate of flow may be determined by introducing into the line an orifice of known size in order to create a differential pressure condition. With no flow through the line, the pressure indicated on the piezometer tubes, upstream and downstream of the orifice plate, will be the same. As flow takes place, a pressure drop occurs across the orifice and is indicated by the difference in height of the fluid in the piezometer tubes.

The difference in pressure, commonly referred to as "differential" is definitely related to flow for any given size orifice. Every "differential" represents a particular flow. Therefore, for a known size of orifice, a measure of the pressure differential is a measure of the rate of flow. It follows that, if means are provided whereby given differentials may be set up, known flows may be established through a line in which an orifice of a selected size is inserted. This is a basic principle which may be applied to create a device used to establish and control chlorine gas feed according to the will of the operator.

Table 1

Characteristics of Chlorine

ITEM	LIQUID	GAS
Composition (Formula)	Cl_2	Cl_2
Purity[1]	99.9%	99.9%
Color	Amber	Greenish-yellow
Odor		Pungent-irritating
Density—gm/L at 0°C, 760 mm	1468	3.214
—lb/ cu ft at 0°C, 39 psi	91.64	0.2006
Spec. Grav.—760 mm—Air = 1.0	——	2.486[2]
Water = 1.0	1.46	——
Vapor Pressure[3] at 0°C (32°F)	39	——
20°C (68°F)	82	——
40°C (104°F)	150	——
Boiling Point	—34.0°C (—29.2°F)	——
Solubility—gm/100 ml at 10°C (50°F)[4]	——	0.98
20°C (68°F)	——	0.716
30°C (86°F)	——	0.572
40°C (104°F)	——	0.46

[1] At ordinary temperatures, dry chlorine (liquid or gas) will not corrode steel, copper, or other common metals. In the presence of moisture, chlorine is extremely corrosive.

[2] 1.0 lb. of liquid will produce 5 cu ft of gas or one volume of liquid will produce 457 volumes of gas.

[3] This pressure is not affected by volume of liquid; hence, chlorine pressure gauges are not indicators of amounts of liquid in container.

[4] Below 9.6°C (49.3°F), chlorine combines with water to form solid chlorine hydrate (Chlorine ice), $Cl_2 \cdot 8\ H_2O$.

Method A

Referring to the diagram in Fig. 1, (Method "A"), the manner in which this principle is applied can be understood. This is the method employed in the Builders-Providence Chlorinizer. To simplify the rate-setting operation, the condition downstream of the orifice is maintained constant. That is, the chlorine feed apparatus is so designed that regardless of the rate of chlorine feed through the system, no change takes place in the downstream condition. This condition, maintained under vacuum for convenience and for safety, is represented as V_c. Because the orifice is of a constant selected size, and since one "leg" of the differential is maintained constant, the other "leg" is the factor which determines the rate of feed.

A reasonably high differential across the orifice is desirable to assure ultimate accuracy; hence, in the Chlorinizer, a slight pressure (not exceeding 12 psi at maximum feed) is employed to govern feed. For every pressure established upstream of the constant orifice (downstream condition is constant), chlorine will feed at a given rate through the system. The upstream condition is represented as P_v, indicating that this is a pressure condition which may be varied at the will of the operator.

Method B

Figure 1 also shows this principle is employed in other chlorine gas feeders. In one design (Method "B") the orifice is maintained constant and a constant condition is established upstream of it. Rate of feed is varied, then, by changing the condition which exists downstream of the orifice—still, in effect, creating a known differential across the orifice. As in Method A, two conditions are kept constant, the orifice and one of the differential "legs." Feed can be governed, obviously, by maintaining any two conditions constant and varying the third.

Method C

A third method of accomplishing control is utilized in another design (Method "C"). In this instance, the differential is maintained constant, and the rate of flow is governed by changing the size of the orifice. This method might be considered somewhat analogous to a faucet discharging to atmosphere with a constant supply pressure behind it. The amount of water discharging therefrom can be governed by gradually opening the faucet, and as long as the supply pressure does not change, the rate of flow will be maintained constant for any given setting.

Basically, therefore, a chlorine feeder utilizes an orifice of some type in a gas flow line with means for keeping constant certain conditions, and with means for establishing at will other conditions and maintaining them at the established value. All other devices which are incorporated in chlorine feeders are included for convenience and safety.

The Complete Chlorine Feeder

Referring to Fig. 2, with the basic operating principle in mind, it is possible to follow the evolution of a chlorine feeder from its simplest form to one which is "complete."

Figure 2, *Line 1*, shows the simplest type of chlorine gas feeder. It consists of a length of silver or plastic tubing attached to a chlorine cylinder. The tank valve is employed as an adjustable orifice. This type of feeder may be satisfactory for an emergency. Continued use is not recommended

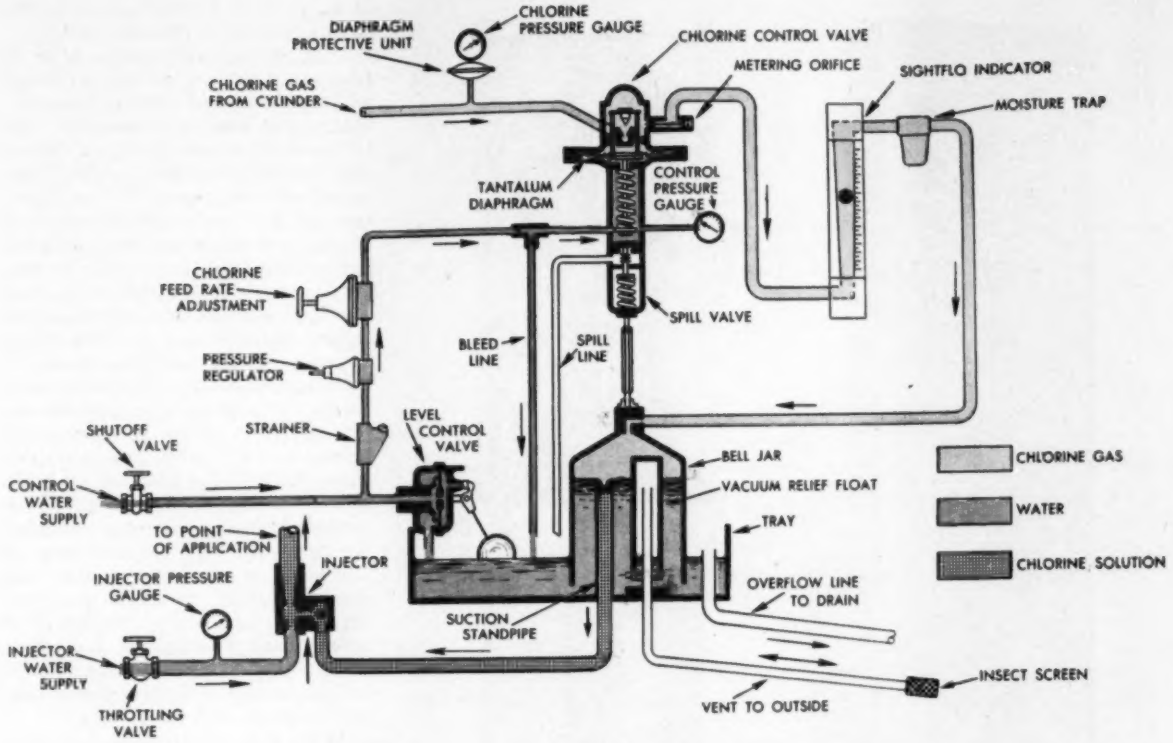


Fig. 3—DIAGRAM illustrating the relationship of chlorine gas feeder components

because of damage to the valve. The cylinder maintains a pressure condition upstream of the valve, and the gas is discharged to a point of application under a reasonably constant head. In effect, therefore, conditions upstream and downstream of an orifice are maintained reasonably constant and rate of feed can be varied by varying the size of the orifice.

If the tank should become exhausted, however, or, after shutting off the valve, if the operator fails to withdraw the discharge end of the hose, the gas remaining in the line will be absorbed gradually and water will be drawn back through the entire system.

Vacuum Breaker Added

To protect the apparatus, therefore, a vacuum breaker should be added, as shown in Fig. 2, *Line 2*. This device will admit air to prevent suckback when excessive vacuum is produced. This is the first refinement incorporated to protect the apparatus and personnel and to assure satisfactory operation.

To avoid the necessity for the operator to make frequent residual tests as a guide to establishing proper feed rate, the next logical step in the evolution of a chlorine feeder is to add a metering device, as shown in Fig. 2, *Line 3*. The Sightflo, a visible-flow indicator, is a direct-reading variable area type meter through which all of the chlorine flows. It will show zero flow when no gas is being fed and will accurately indicate any variations from set feed rate.

A meter having been established, the next logical step is to strive for dependable maintenance of flow rate. Since chlorine cylinder pressure varies with temperature, the condition upstream of the throttling valve will not remain constant. The condition downstream also may vary because of changes in conditions of head at the point of application. These variable conditions make necessary frequent adjustments of the valve setting to maintain an approximately constant rate of feed.

Compensating Valves Added

To assure that these variable conditions will not affect control, compensating valves are added upstream and downstream of the orifice. The design of these valves will be dictated by the control method used (Fig. 1). *Line 4*, Fig. 2 shows the arrangement if the condition downstream of a constant orifice is to be kept constant and the condition upstream is to be varied to control flow. The back pressure valve will maintain a constant condition downstream of orifice O_c. The compensating and control valve performs two functions: It provides a convenient means for establishing the upstream condition (P_v, Method A, Fig. 1), and it keeps constant that established condition regardless of variations in cylinder pressure.

At this stage in the evolution of a chlorine gas feeder, there exists a pressure-type, direct-feed device that will accurately control the flow of chlorine introduced directly into a pipe or channel carrying the flow to be treated. This device has certain limitations. It is not fool-proof, inasmuch as the gas is under pressure throughout the system; any piping leak will allow gas to escape. Also, being a direct-feed device, it has the inherent weaknesses of the direct feed system, which have been pointed out previously. Chlorine feeders of this type are available and in limited use for special applications.

To overcome the difficulty in attempting to introduce chlorine gas directly at the point of application, a device is added to bring the chlorine gas into intimate contact with a supply of water and thus produce a chlorine solution. This solution is concentrated and relatively stable; it can be introduced safely and easily

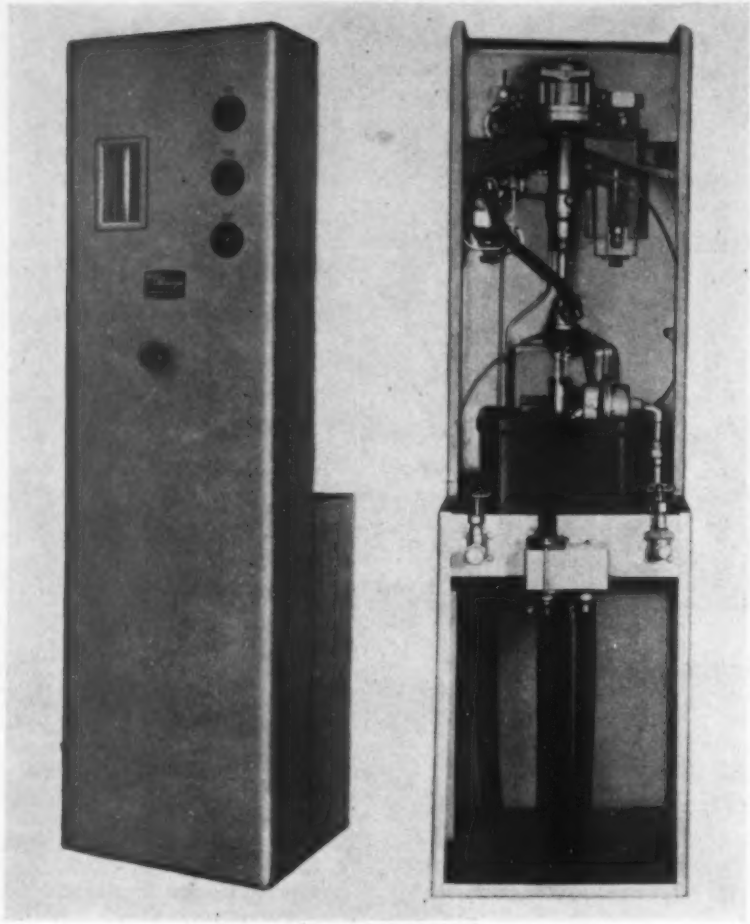


Fig. 4—A CHLORINE FEEDER unit, front and back views

into an open channel, a closed pipe line, or the suction end of a pump. An injector, sometimes called an aspirator or eductor, is an excellent mixing device. The application of an injector to a direct-type feeder is shown in *Line 5*, Fig. 2. The injector also will induce a vacuum throughout the piping system of the feeder. This effect overcomes one of the weaknesses of the direct-type feeder, in that gas cannot escape while the unit is operating, even if a slight leak occurs in the piping.

The compensating and control valve is manually operated, however, and if a major break or leak occurs downstream of the valve, chlorine will continue to escape freely, endangering personnel and the premises. If the injector fails, chlorine gas will continue to flow through the system directly to the point of application with possible damage. If there is a slight leak through the valves in the system during a shut-down period, chlorine will bleed through the injector directly to the point of application, possibly endangering personnel or causing property damage. This type of machine is the semi-vacuum type solution feeder, previously defined.

Pressure Relief Provided

Those devices which will overcome these weaknesses are shown in *Line 6*, Fig. 2. A pressure relief has been added in combination with the vacuum breaker. The compensating valve has been designed so that it will close instantaneously on loss of vacuum (a condition which would occur if the injector fails, if water supply fails, if the diffuser at the point of application blocks up, or if there is a break in the gas system).

Another refinement (Fig. 2, *Line 6*) is a simple means for maintaining a constant vacuum downstream of the orifice, through the medium of a standpipe of fixed height within the bell jar. This device limits the vacuum in the system and maintains it at a constant established value. Also added is a rate control valve, by which means an operator may establish the value of P_v (Fig. 1, Method A) and thus control the rate of chlorine feed.

With all these refinements (Fig. 2, *Line 6*) there is created a device which provides: (1) means for establishing and keeping constant, a differential across an orifice to control chlorine feed accurately; (2) a vacuum governed system which will prevent gas leaks and automatically shut off chlorine gas under any operating misfunction; (3) an injector to create the operating vacuum and a solution feed for safe and efficient application of chlorine to flow being treated; (4) an indicating device to show rate of feed; (5) a convenient means for setting or controlling the rate of feed; (6) a pressure relief safety device to vent gas to outside atmosphere, if the gas shut-off valve should leak during shutdown; (7) A vacuum breaker to prevent suck-back during shutdown; (in the type of unit described vacuum breaker and pressure relief functions are performed by a simple floating flask, independent of springs and check valves; this device is located in the bell jar, where it is conveniently visible to the operator).

With these refinements, there is produced a full-vacuum-solution type chlorine feeder; one that is complete and provides accurate control of chlorine feed, protects personnel, apparatus and premises, and safely delivers the chlorine to the point of application. The details of the various elements and their physical relationship in the final product are shown in Fig. 3. The actual chlorine feeder is shown in Fig. 4.

Methods of Control

There are four basic methods of controlling the operation of chlorine gas feeders, as illustrated in Fig. 5.

Manual Control equipment is put into operation and shut down manually by the operator; the rate of chlorine feed in pounds per 24 hours is established by manual adjustment.

Semiautomatic Control or Start-Stop equipment feeds automatically in sequence with pump or timer operation at a rate manually preset. A variation of semiautomatic control is pump-governed "step control," used in multiple pump installations in which chlorine feed is automatically synchronized to provide proper dosage for a particular pump or combination of pumps in operation. In semiautomatic or step control, the operator preselects the rate and the apparatus then starts and stops in step with the pump or other controlling device to provide chlorine when desired at the preselected rate.

Automatic-Proportional Control equipment adjusts the chlorine feed rate automatically in accordance with flow changes to provide a constant pre-established dosage for all rates of flow. The feeder operates continuously, the dosage is established by the operator, and the machine then automatically follows the flow, changing the feed rate to maintain a constant dosage. This type of control is commonly employed in plants where the rate of flow being treated varies. Pacing control can be teamed with program control so that the dosage can be varied according to flow and pre-established schedule of dosage rate. A variation of paced operation is control by Oxidation-Reduction Potential, wherein an ORP (Redox) controller is substituted for flow control. This type of control is used in cyanide waste treatment and other treatments involving oxidation or reduction.

Program Control effects automatic changing of the chlorine feed rate throughout the day to follow changes in required chlorine dosage in accordance with a pre-established schedule. The chlorine feeder operates continuously, but the rate of feed is automatically adjusted to follow the pre-established program. This type of control is employed more frequently in sewage and waste chlorination than in water chlorination.

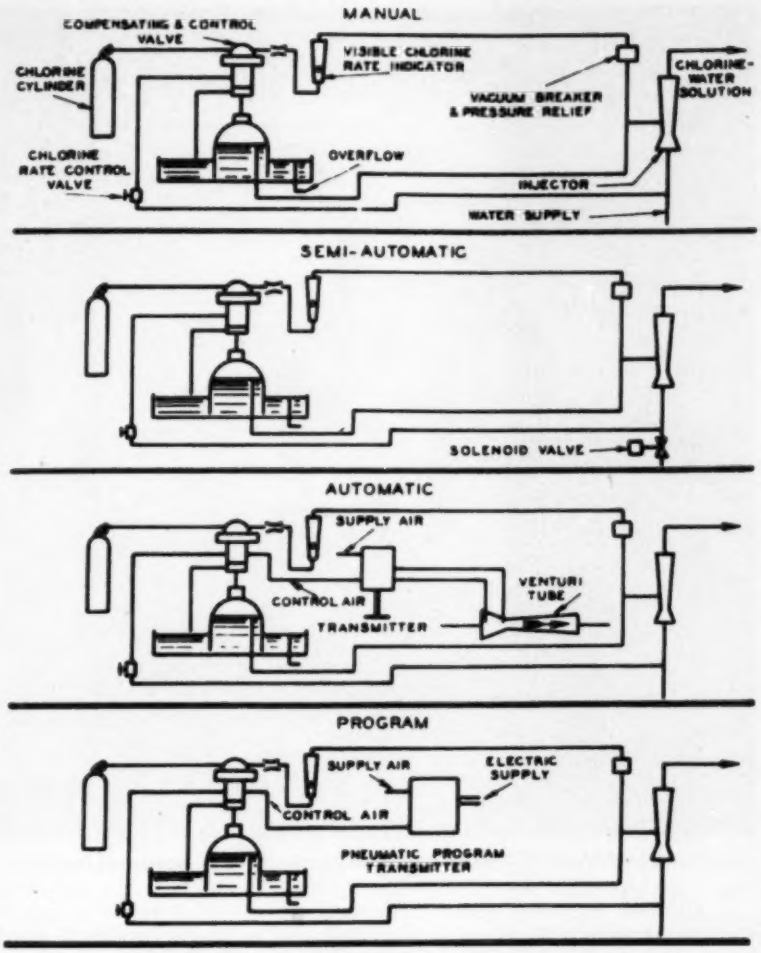


Fig. 5—CONTROL METHODS used in chlorine feeder design

Feeder Installation

The most important factor in installation is that of selecting the location. The ultimate discharge point of chlorine solution should provide two essential conditions—quick and thorough mixing of chlorine solution with the liquid to be chlorinated and sufficient contact time to effect the desired reaction or disinfection. Desirable conditions, although not essential, include low pressure at the point of chlorine application (an open channel with a minimum depth of two or three feet, or the suction line of a pump make ideal points), and a short run of chlorine solution lines from feeder to point of application.

In selecting the location of a chlorine feeder, accessibility is of prime importance. The equipment should be located relatively close to the point of application where water supply is available in sufficient quantity and at suitable pressure. The location should be convenient to truck or railroad delivery and should provide facilities for container handling and storage. Of course, electric power must be available for light, heat, pumps and evaporators, and suitable drains should be available to carry off overflows.

Water supply is an important factor in chlorine feeders. In the solution type feeder, the eductor or injector is designed to provide the necessary operating vacuum. A normal water pressure of approximately 30 pounds per square inch will operate chlorine feeder discharging solution against relatively little back pressure (four to five feet of water).

As back pressure increases, the operating pressure supplied to the inlet side of the injector must increase. As a rule of thumb, it may be considered that the supply pressure to the injector should be 2½ to 3 times the pressure existing at the injector discharge. It is important that adequate pressure is maintained when the equipment is operating. The lines conveying water to the feeder should be large enough so that a pressure drop does not occur when the water is drawn to operate the feeder. The operation of other taps connected to the same line should not appreciably affect the supply pressure.

Temperature Considerations

Heating facilities must be provided to assure satisfactory temperature control of the feeder area, which should be maintained at normal even-room temperature in the coldest weather. The principal fact with respect to heating is that there shall be sufficient heat available to vaporize the needed amount of chlorine from the cylinders—that is, that it shall be possible to transfer sufficient heat units through the walls of the container into the liquid so that the desired rate of withdrawal can be maintained. The only other reason for maintaining the temperature in a chlorine feeder room is to assure that the water within the apparatus will not freeze in cold weather.

Of considerable importance is the fact that if there is any temperature variation between the feeder room and the cylinder room, the cylinder room should be maintained at the

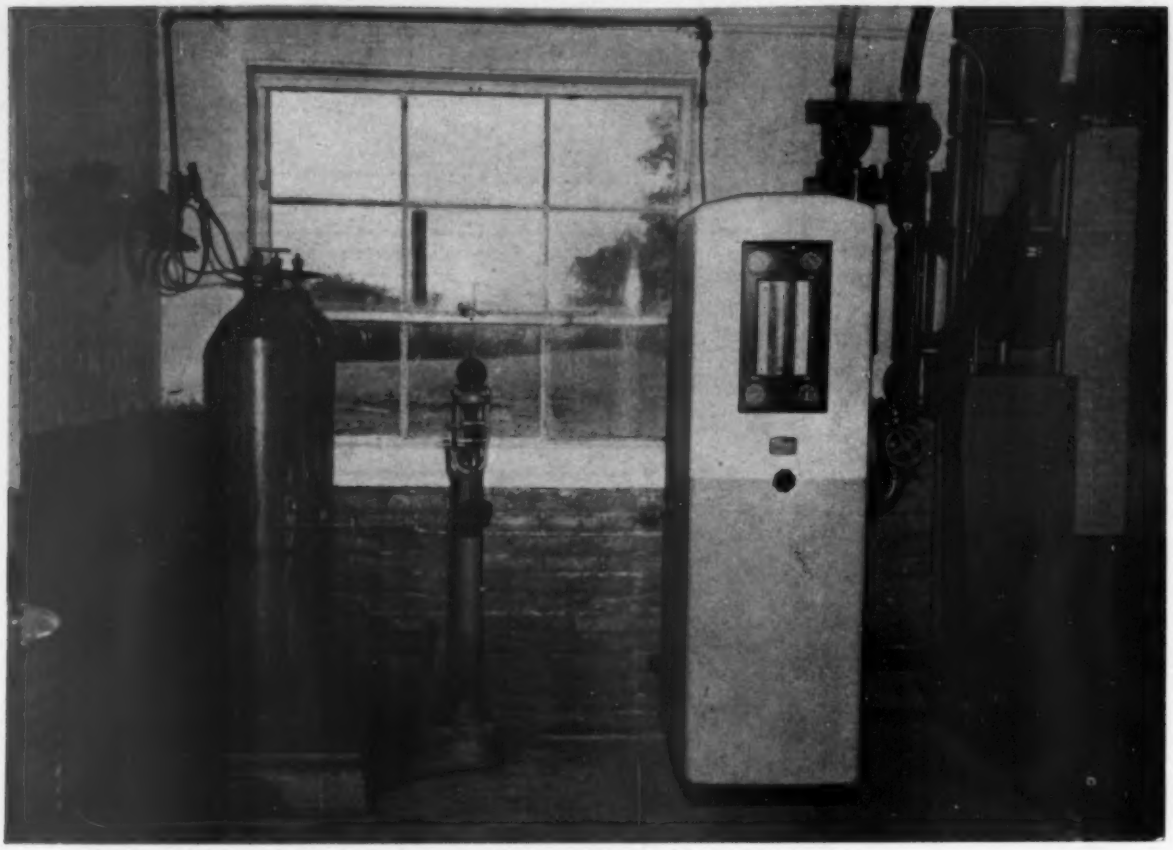


Fig. 6—CYANIDE WASTE treatment—an application to the treatment of industrial wastes

lower temperature and the connecting piping from the cylinder to the feeder should never be allowed to drop below the cylinder temperature. Avoid carrying it against cold walls, in front of windows, in drafty areas and the like. The illustration at the head of this article shows an installation embodying the principles outlined above. Figure 6 is a photograph of a Chlorinizer operating in a cyanide waste treatment installation where the cyanide waste effluent is pumped through the injector, providing the vacuum and insuring the immediate and intimate control of chlorine and waste so essential for effective destruction of the cyanides.

Accessory Equipment

Accessories make chlorine feeder installations more flexible. If there are two or more points to be chlorinated, it is not always necessary to use more than one chlorine feeder. The solution from one feeder may be directed into a manifold, from which it may be distributed to two or more points.

Scales are desirable to keep records of daily quantities of chlorine feed, and also as the only accurate check on the amount of chlorine remaining in the cylinders. Chlorine flow recorders are available and desirable in some instances to provide a permanent record of the rate of chlorine feed. Booster pumps are necessary whenever high back-pressure conditions exist and sufficient supply is not available to assure proper operation of the eductor. Gas masks are important accessories and must not be overlooked. Other safety devices and alarm systems are available to aid in unattended operation.

If chlorine feeder equipment is well-engineered, carefully selected and properly installed, it will control chlorine feed safely, accurately and effectively in whatever capacity the process of chlorination is being used.

Applications of Chlorine to Treat Industrial Waste

With some 8000 untreated industrial wastes in this country, the total economic loss probably is several billion dollars annually. Losses are incurred through the discharge of unsalvaged materials carried by the industrial wastes. Further, the wastes are responsible for corrosion, increased costs of water treatment, increased costs of public health measures, reduction in value of property, spoilage of recreational areas and damage to the fishing industry. Treatment of wastes is necesary to reduce these staggering economic losses.

Although chlorination is not a panacea for all problems, it is a useful method of waste treatment in many cases. Its utility depends on several factors, best understood by reviewing briefly the general type of waste and methods of treatment.

Classification of Waste

Industrial wastes may be classified in several ways; for example: (a) Source (acid, coke, paper, steel, etc.); (b) Organic or Inorganic; (c) Toxic or Non-Toxic; (d) Metallic; (e) Chemical; (f) Mineral Oil; (g) Inert; and (h) Mixed.

Another broad classification is based on the industry from which the waste is derived:

Chemical Industry, Fermentation, Food Processing, Mining, Metal Processing, Petroleum, Pulp and Paper, Textile, etc.

Treatment Processes

In considering the treatment process to be employed for any waste, thought should be given first to the possibility of salvage, which, in any manufacturing operation, constitutes one of the most effective waste treatment processes. A salvage operation may involve a change in the manufacturing process, recovery of usable by-products, or re-use of treated waste in processing. Salvage operations may result in savings beyond the cost of the treatment process. The savings may be enough to turn a liability into an asset. When all possibilities of salvage have been exhausted, some form of treatment may still be necessary.

The extent of treatment required is dependent upon numerous factors. These include the strength of waste, its toxic content, dilution in the receiving stream, and nuisance characteristics of the waste. The specific waste treatment process to be applied must be selected. The selection is governed by the individual waste, its source, and the prevailing conditions. The economics involved in operating different processes (chemical costs, construction costs, labor costs) must be considered.

The source of waste may suggest the treatment process required.* Inorganic waste, for example, generally will require chemical and mechanical (physical) processing. Organic waste, on the other hand, will respond to biological treatment and may or may not also require chemical and mechanical processes. Mixed waste probably will require mechanical and biological treatment, and may or may not also require chemical treatment.

Chlorination

This paper is particularly concerned with chlorination as a unit waste treatment process. Chlorine has proved effective as a complete treatment process (stabilizing the waste) or as a pretreatment process (conditioning the waste to permit more complete and economical final treatment.) Table 2 lists wastes which are economically treatable with chlorine.

The list in Table 2 should not be construed as complete. Many wastes, in addition to those shown, can be handled effectively by chlorination, but not as economically, at present, as by other methods. Research continues, and new applications of chlorine are constantly being developed. Most applications of chlorine in industrial waste treatment have been developed since 1930.

Table 2

Wastes Treatable with Chlorine

CHEMICAL INDUSTRY	**METAL PROCESSING**	**PULP AND PAPER**
Coke and Gas	Cyanide	Paper Board
Dye Manufacturing	Plating	(News and Chip)
Explosives	Pickling Waste	
Pharmaceuticals		
Phenol	**FOOD PROCESSING**	**TEXTILE**
Plastics	Beet Sugar	Wool Scouring
Rubber and Reclaiming	Frozen Food	
Starch	Meat Packing	
Sulfur		**MISCELLANEOUS**
		Chewing Gum
FERMENTATION	**PETROLEUM**	Rendering Plants
Biologicals	Tank Washing	Tanning

The efficiency of chlorination as a waste treatment process depends on the inherent chemical activity of chlorine. Chlorine is a strong oxidizing agent and a powerful bactericide. It is an active element which will combine with many chemicals both inorganic and organic; these combined forms are stable compounds which have little or no nuisance characteristics when discharged into receiving bodies of water.

Chlorine Reaction Products

If the waste contains compounds such as sulfides, cyanides, mercaptans or other chemical compounds in a reduced state, chlorine will oxidize and stabilize the waste. This action of chlorine is utilized in the treatment of phenols, cyanides, coke and gas wastes, plastic wastes, etc.

Waste from processes involved in rubber, starch, biologicals, fermentation, food processing, pulp and paper, petroleum, wool scouring, rendering, tanning, etc., may contain organic chemical compounds capable of being decomposed by bacteria. The decomposed waste causes a nuisance condition at the plant or in the receiving body of water. Chlorine often will combine with such compounds to form an inert and stable substance which bacteria cannot decompose. Unsaturated chemical compounds often fall into this class. Chlorine may kill bacteria in a waste and thus prevent its decomposition.

In the case of process water and boiler water, chlorination is used as a bactericide in order to prevent slime formation in condensers and spoilage in process operations. Treatment of drinking water with chlorine is used principally for disinfection, but also may be used for elimination of taste and odors.

Chlorination of sanitary sewage is used principally for disinfection purposes. It reduces bacterial activity and delays decomposition of organic matter until the discharged waste is sufficiently diluted in the receiving waters to prevent anaerobic decomposition and nuisance conditions.

W&SW

Sea Water Distillation For Industrial Use

Pacific Gas and Electric Co. has announced that it will install sea water evaporators to produce fresh water for boiler operations in its 44-million-dollar steam-electric generating plant under construction at Morro Bay, San Luis Obispo County.

While the process has been common aboard ships, this is believed to be the first industrial application of ocean water distillation anywhere in the nation.

Two sets of the sea-water evaporators will be installed—one for each of two giant boilers in the power plant. Each set will have a production capacity of 50 gallons of fresh water a minute, or 72,000 gallons a day.

The decision to design salt water evaporators was reached after exhaustive inquiries into the availability of fresh water from other sources in the area.

*Unit waste treatment processes commonly employed include: Aerobic Biological Oxidation, Anaerobic Digestion, Chemical Coagulation and Sedimentation, Chemical Oxidation, Chlorination, Dewatering, Drying, Incineration, Filtration, Flotation, Flocculation and Sedimentation, Lagooning and Irrigation, Neutralization, Screening and Sedimentation.

More About "Quick Chlorine Dioxide"

Another experience with an emergency chlorine dioxide generator set up to control a serious taste and odor problem

by CORNELIUS W. KRUSÉ

Mr. Krusé is Associate Professor of Sanitary Engineering at The Johns Hopkins University, Baltimore, Md.

In the following letter, he refers to an item published in our April 1953 issue on page 150. That item told the story of a water plant operator in the Pacific Northwest, who "dreamed up", built and operated an emergency chlorine dioxide generator.

The experience reported by Mr. Krusé illustrates a different way of doing the same thing. We believe this sequel story will be of interest to our readers.

Dear Editor:

The brief article printed in *Water & Sewage Works* titled "Quick—The Chlorine Dioxide!" is responsible for this letter.

I believe there must be some common bond between people who have really experienced *bad* taste and odor problems in water supplies, because just the title started me turning up about a hundred RPM's.

I happened to be working in the lower Tennessee River area just after the T.V.A. impoundages were made. You will recall, before those new reservoirs got "ripe" they were responsible for a series of bad taste and odor experiences. Being younger and more ambitious, I had set out to control this problem. I made plankton counts all up and down the river to try to forecast the trouble before it came. They (T.V.A.) had built me a pilot plant in which I hoped to find the best way of controlling the odors when they developed. By the summer of '45 we were ready for the problem to arrive, or so I thought.

Each filter plant treating this water had more or less agreed to select a specific treatment and stay with it until the unpleasant condition was cured by the arrival of cold weather in the fall. This had the makings of a super experiment that no jar tests could approach. Some of the smaller plants, unable to do any additional treatment, would be full-scale controls!

Waiting for the problem to arrive was nerve-racking for me and I ran around from plant to plant like a "young bird dog." The fact that the operators knew I meant well was the only reason that they didn't chain me to the back porch! Finally, the day arrived with a bang! Let us veil the tragic sequel, for history repeats itself; under the stress of the phone calls, unwanted advice by "experts" and salesmen, the whole scheme went to pot. All methods were certainly tried, but the switching of materials every other day gave us neither the negative nor the positive results we were looking for.

One treatment plant, supposed to be a control because it could not afford carbon in large amounts and lacked the capacity for applying breakpoint chlorination, did manage to get a drum of technical sodium chlorite. So we doped out a way, in a hurry, to generate chlorine dioxide. I think the sketch gives all the necessary details except, of course, the string and wire necessary to hold such a makeshift rig in order.

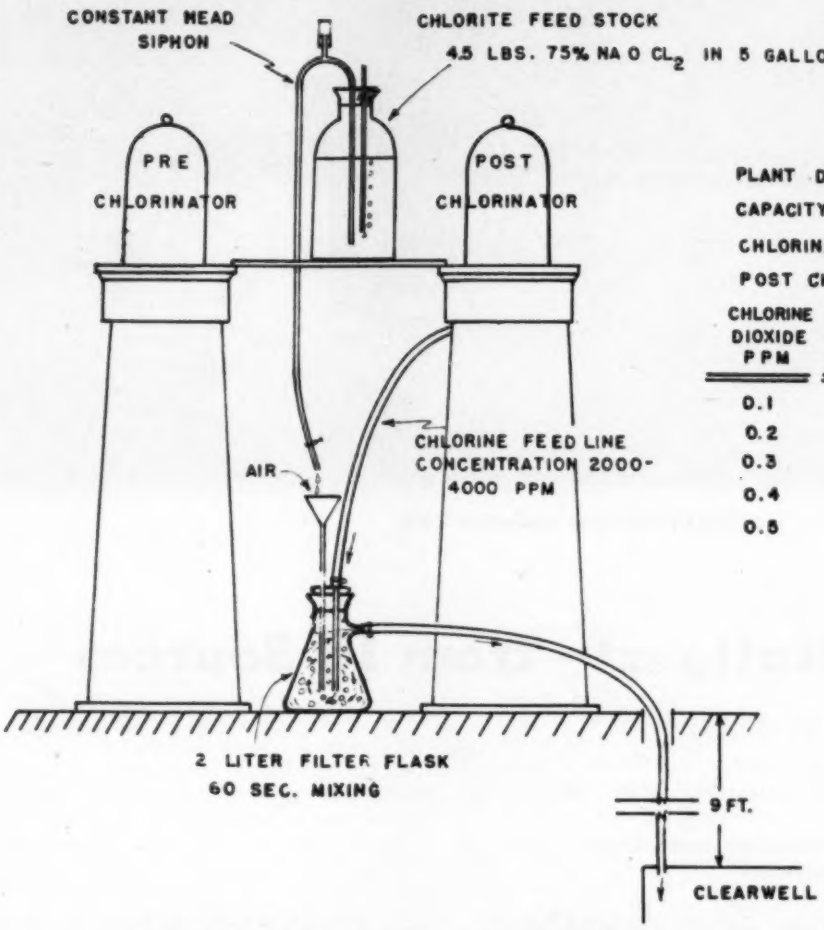
How did it work? Well, that will always be a question: Some of us thought it did a fine job of reducing tastes and odors. According to my notes, it was doing about as well as a plant three miles upstream. The upstream plant was allegedly feeding a breakpoint dose of chlorine, followed by 15 ppm activated carbon. I choose to call that Plant B, and our 0.2 to 0.5 ppm

Table I

Threshold Odor Number of Water Samples

Date	Plant A		Plant B	
	Raw Water	Finished Water	Raw Water	Finished Water
9/5/45	—	—	24	3.2
9/6/45	42	32.0	42	10.0
9/12/45*	30	19.0	24	7.5
9/13/45	30	5.6	50	7.0
9/15/45	26	14.0	30	8.0
9/17/45	26	10.0	50	16.0
9/18/45	50	11	40	16.0
9/19/45	32	18	42	32.0
9/20/45	—	—	56	18.0
9/21/45	56	18	56	18.0
9/22/45	56	18	56	42.0
9/23/45	—	—	75	32.0
9/24/45	—	—	75	24
9/25/45	56	13	75	24
9/26/45	—	—	100	18
9/27/45	—	—	56	18
9/28/45	56	18	75	24
9/29/45	—	—	75	24
10/1/45	—	—	75	32
10/2/45	—	—	75	24
10/3/45	—	—	42	18
10/4/45	—	—	56	18
10/5/45	—	—	56	13

*Chlorine dioxide feed started



PLANT DATA:

CAPACITY 3 FILTERS 0.5 MGD = 1.5MGD

CHLORINATORS W&T TYPE MSV-III

POST CHLORINATION 0.5 PPM

CHLORINE DIOXIDE PPM	TECH. SODIUM CHLORITE LBS./DAY/FILTER	CHLORITE FEED RATE ML./MIN./FILTER
0.1	0.744	2.2
0.2	1.488	4.4
0.3	2.232	6.6
0.4	2.976	8.8
0.5	3.720	11.0

METHOD USED by the author to generate Chlorine Dioxide at a treatment plant in the lower Tenn. River area

chlorine dioxide treatment Plant A. The results are summarized in Table 1.

About the same reduction of odors was accomplished until the middle of October. When the problem ended, we decided to be ready for it the next season. For some reason, however, it never came back again. Who knows—maybe prayer is the best taste and odor control method after all.

W&SW

New "Clean Waters" Film Produced by GE

A new version of "Clean Waters," a film calling attention to pollution of water resources, will be premiered by the General Electric Company at the annual meeting of the Federation of Sewage and Industrial Wastes Association in Cincinnati, October 10 through 14. The 25-minute, full-color, sound motion picture is designed to create an awareness to the growing of stream pollution and enlist public and industry support for programs geared to meet the problem.

Dramatizing the importance of clean water to the individual and his community, the 16 mm. film outlines the need for immediate action to combat existing and future pollution areas in order to assure safe water for health and recreational purposes.

Besides spelling out this nationwide threat, the film also prescribes the remedy: improved expanded water supplies through more industrial waste treatment, modernized municipal sewage disposal plants, and construction of municipal treatment facilities where none exist.

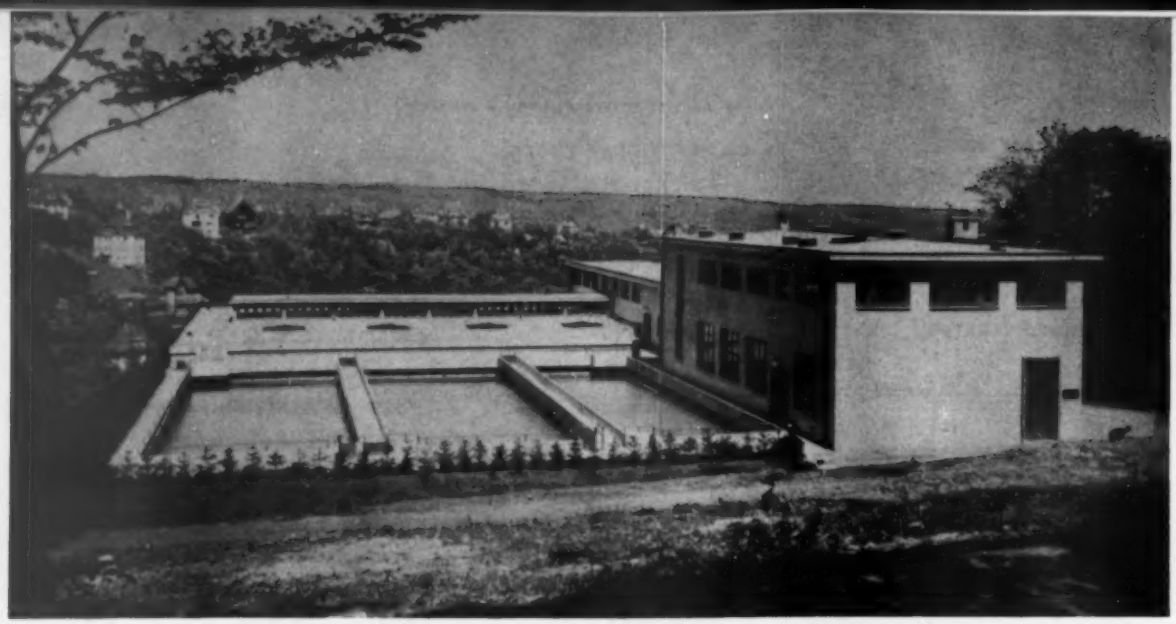
Air Pollution Control Course At Rutgers University

A regular first term course on "Principles of Air Pollution Control" is being offered at Rutgers University, New Brunswick, N. J. The course is conducted at the Dept. of Sanitation on Fridays from 3:00 to 6:00 P.M. It is open to industrial, governmental and other professional personnel interested in air pollution control, as well as to qualified students at Rutgers.

Applications for information and admission should be addressed to University College (Evening School), 77 Hamilton Street, New Brunswick, N. J.

N. J. Operators' License Examination Filing Date Set

Those desiring to take the next New Jersey examination for Water and/or Sewage Works Operators wishing to become licensed operators must have the customary application on file with the Bureau of Examination and Licensing of the N. J. State Dept. of Health, Trenton, N. J., not later than Nov. 10th.



On the City's hills—the Gallenklinge Works

Water for Stuttgart—from 16 Sources

Stuttgart, Germany, is a city of hills.
It has 72 different pressure zones and water is supplied
by 74 reservoirs varying in elevation from 700 to 1600 feet.

by **CAPT. H. L. BLANFORD,** *Asst. Chief, Occupational Health Branch, Office of the Surgeon General, Washington, D. C.*

IN GERMANY, as throughout most other parts of the world, the provision of a safe and adequate supply of water is one of man's fundamental needs. The city of Stuttgart has been participating in efforts to meet this need for many hundreds of years, and the distribution system of its municipal water supply has grown by leaps and bounds until it now serves a metropolitan population of approximately 500,000. The next "leap" in its growth is a plan to bring water from Bodensee (Lake Constance), which lies in the foothills of the Bavarian Alps between Germany and Switzerland, some 90 miles to the south. This project is expected to cost over $35,000,000 and Stuttgart's share of the volume available will be about 32 million gal. of water per day.

Stuttgart is located in Land (State) Wuerttemberg-Baden, along each side of the Neckar river, in the midst of one of Germany's best grape producing areas. A contour map of the city will show that its location along the Neckar River is in about as rough a spot as one would select to build a metropolis—much worse than the hills of San Francisco.

Complex Distribution System

There are 16 separate water sources for Stuttgart, comprising a water distribution company (Landeswasserversorgung); surface water treatment plants; infiltration galleries; "well" fields; and spring developments. Pressure in the distribution system varies from 3 to 8 atmospheres in 72 different pressure zones, and the water is supplied by 74 reservoirs ranging in size from 25,000 to 5,250,000 gallons.

All storage of water is in ground level reservoirs (the topography precludes the necessity for any elevated storage), and reservoirs have been built at elevations between 700 and 1600 feet above sea level. Forty-four manually and automatically operated pump stations are used to supply this series of zones and reservoirs. Electric telegraph systems are used to control the pumps, or to signal the operator, when the water level in the next higher zone reservoir falls below a predetermined height.

Spring Water Supplies

The spring developments are located in groups of 6 or 8 on the hills, usually around the periphery of the metropolitan area but in one instance some 12 miles from the city limits. Construction is similar throughout, an underground stream having been intercepted in the side of the hill with a concrete collecting basin, from which the water is pumped or flows by gravity to the distribution system. All of these supplies, except one where liquid chlorine is used, are chlorinated at the source with a hypochlorite. No other treatment is given. Flow from each group of springs is only about 40,000 gpd.

Infiltration Galleries

A typical infiltration gallery is the Neckartailfingen source, located some 12 miles up-river from the city limits. A 300-meter section of 60 x 60 cm, stone-masonry gallery, with cover 4 to 5 meters thick is located on the north side of and at a right angle to the Neckar river. An identical section 200 meters long is located on the south side, the two galleries being connected under the river with a header made up of 2—250 mm diameter cast iron pipes laid side by side. A 25,000-gallon collecting basin, positioned at the extreme north end of

Stuttgart's Berg. water filtration plant

this construction, serves as a terminus for the pump-suction lines. Disinfection is again the only treatment given, being accomplished at this location with chlorine and ammonia.

The method of recharging at this source is rather interesting. Water is pumped from the Neckar river through 2 pressure filters into 7 recharge ditches parallel to and at varying distances from the collecting galleries. These ditches are 6 meters square in area; they have concrete walls, and contain graded sand and gravel to a depth of approximately 1 meter.

Slow and Rapid Filters

Water from either the Neckar river or from 2 small lakes is treated in the city's 3 filtration plants. Practices differ but slightly from the U. S.; lime is used for pH control, aluminum sulfate and sodium aluminate as coagulants, activated carbon for taste and odor control, and chlorine gas for disinfection. However, combinations of both slow and rapid sand filters are used and the effective sand sizes are smaller than those used in present-day filters in the U. S.

Four so-called "well" fields have been developed at various locations throughout the city. The "wells" really should be called "collector wells," as most of them are made up of a horizontal, perforated concrete pipe (200 to 300 meters long, with 4 to 5 meters of cover) laid parallel to and at varying distances (100 to 600 meters) from the Neckar river. One end of the pipe terminates in a collecting basin to supply the pump suction lines. A few of these "collecting wells" have a vertical collector of perforated concrete, with a pump station built on the top. Chlorination is the only treatment given to water from these well fields.

Water purchased from Landeswasserversorgung is chlorinated as it enters the city, the point of chlorination being just ahead of a 5.0 mg capacity reservoir.

In spite of this "hodge-podge" of reservoirs, heterogeneous water sources, cast iron pipes over 100 years old, and the plethora of pump stations, sanitary control of the Stuttgart water is superior. Daily determinations of chlorine residual, taken by the U. S. Army at 15 widely dispersed locations, vary only from 0.35 ppm near points of chlorination to 0.1 ppm or 0.2 ppm some 10 to 15 miles distant. In addition, approximately 75 samples are examined bacteriologically at a U. S. Army laboratory each month. A sample of unsafe sanitary quality is very rarely found.

The entire staff of "Der Technischen Werke der Stadt Stuttgart" is to be complimented for ingenuity, integrity and farsightedness in assuring their community a plentiful and potable water supply both at present and in the future.

W&SW

Control gallery (left) and rapid sand filters (right) in the modern Berg. plant

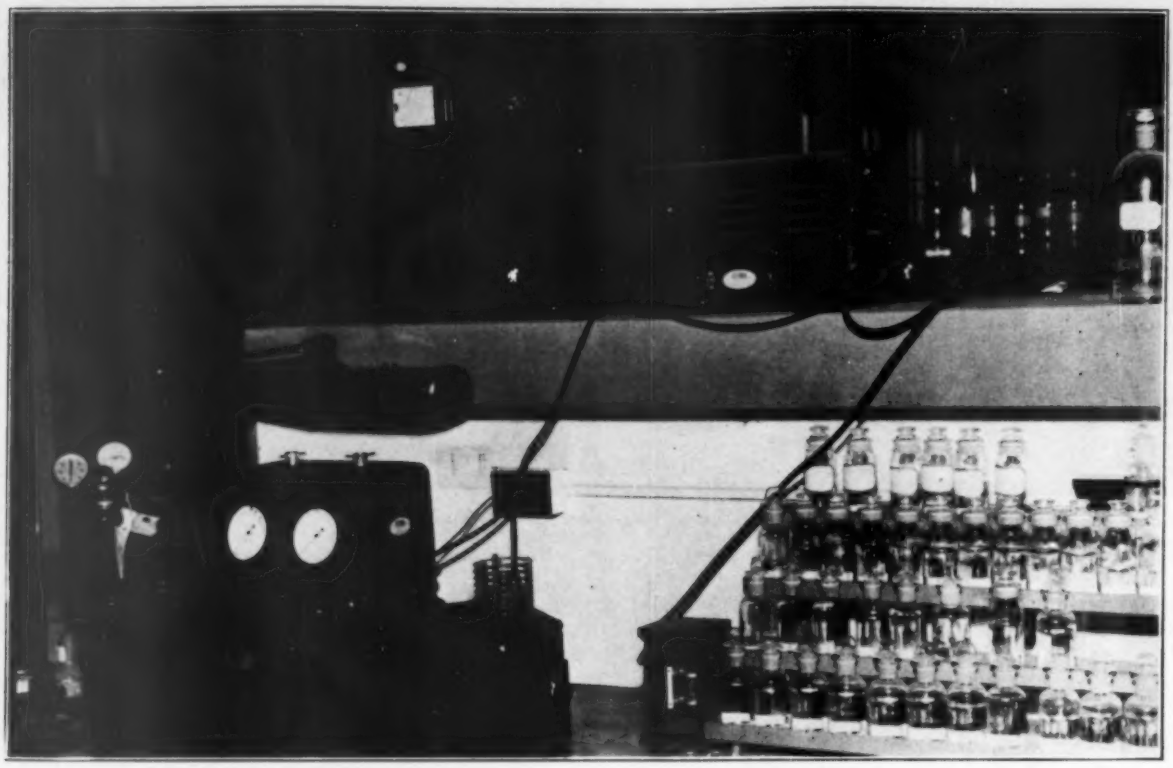


Fig. 1—RAPID DETERMINATION of sulfates uses spectrophotometer with (above) flame attachment and photomultiplier

A Turbidimetric Sulfate Determination

This rapid spectrophotometric method was developed to eliminate visual error and correct for turbidity

by J. F. THOMAS and J. E. COTTON, *Sanitary Engineering Research Laboratories, Univ. of California, Richmond, Calif.*

THE gravimetric method for the determination of sulfate ion content has long been accepted as the primary standard procedure. It is a tedious determination to carry out and has limitations, principally in the range of low sulfate ion concentrations which are likely to be encountered in the water works laboratory.

The turbidimetric method, presented in this paper, is designed specifically for application to water samples which contain a low concentration of sulfite ion. Unlike the gravimetric method, results may be determined in a short time. The good replication of results obtained by this method indicates a high degree of precision; statistical analyses of the results show it to be reliable.

The Turbidimetric Method

Many turbidimetric methods[1,2,3 and 4] for the determination of sulfate ion have been proposed, all of which are very similar. A source providing barium ion is added to a solution containing sulfate ion, causing the formation of turbidity due to the formation of insoluble barium sulfate. The proposed method develops the turbidity in a like manner but measures it spectrophotometrically, thus eliminating the large indeterminate optical fatigue error normally associated with the visual comparison method of the turbidimeter and nephelometer. In addition, the method automatically corrects for any color or turbidity already present in the sample.

Apparatus

The turbidimetric sulfate determination can be performed with any photometer that operates in the visual range. With one exception all turbidimetric determinations reported in this article were made with a Beckman Spectrophotometer, Model DU, using cells having a one-centimeter light path (see Fig. 1). For comparative purposes between instruments, a calibration curve was constructed with a Fisher Electrophotometer using circular cells having a two-centimeter light path.

Reagents

Acidified Salt Solution. Dissolve 200 grams of reagent grade sodium chloride in 800 ml of distilled water and add 20 ml of concentrated reagent grade HCl.

Barium chloride crystals, reagent grade. Pass crystalline barium chloride through a sieve shaker, retaining those crystals which pass the #20 mesh but are retained on the #30 mesh.

Potassium sulfate standard stock solution, 100 ppm of sulfate ion. Dissolve 0.1840 grams of potassium sulfate in water and dilute to 1 liter. Each ml is equivalent to 0.1 mg of sulfate as sulfate.

PROCEDURE

A 50 ml aliquot of the sample containing not more than 80 ppm sulfate ion is measured into a 150 ml beaker; samples containing higher concentrations of sulfate ion should be accurately diluted with distilled water. To the 50 ml aliquot add 10 ml of the acidified salt solution, mix thoroughly, withdraw a 5 ml portion, and place in a spectrophotometer light cell for subsequent determination of the initial turbidity. The initial turbidity is the blank correction.

To the remainder of the sample in the beaker add approximately 0.3 gram of barium chloride crystals by means of a small scoop. (A glass or metal scoop that approximately delivers this amount is convenient and sufficiently accurate inasmuch as a large excess of barium ion is involved.) Stir for exactly 1 minute (a magnetic stirrer is desirable); then allow the solution to stand for exactly four minutes. Immediately transfer a portion of this solution to a light cell and read the optical density on the spectrophotometer at a wave length of 380 mμ. (Any wave length up to 500 mμ is acceptable, but the magnitude of the optical density readings decreases at the longer wave lengths.

The optical density of the initial turbidity is read concurrently and subtracted; the resultant optical density is a function of the barium sulfate turbidity. (This subtraction, or blank correction is made automatically by the Beckman Spectrophotometer.)

The sulfate ion concentration is read directly from a calibration curve based on standard sulfate solutions treated by the same procedure. The calibration curve (see Fig. 3) covers a range from 2 to 80 ppm of sulfate ion and is prepared from solutions made by accurate dilution of the potassium sulfate standard stock solution with distilled water.

The samples should be run at a temperature that does not vary more than ±3°C from the temperature at which the calibration curve was made.

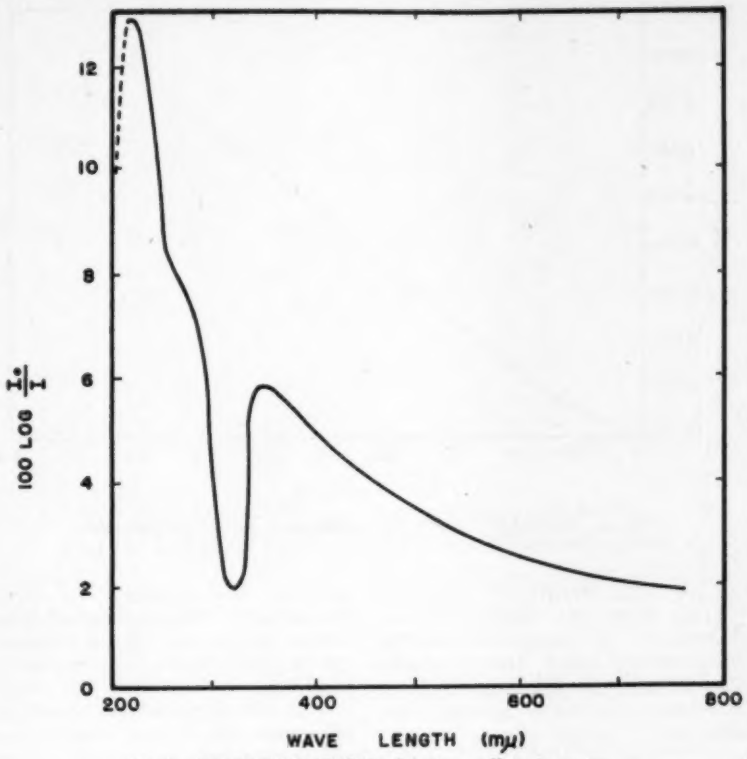


Fig. 2—ABSORPTION CURVE of barium sulfate in water
Barium sulfate concentration is equal to 12.1 mg per liter.

RESULTS

A standard light absorption curve was constructed to determine the optimum wave length for measuring the optical density of the barium sulfate turbid solutions. (See Fig. 2.) There are two observed maxima—220 mμ and 350 mμ. That occurring at 220 mμ was rejected because special apparatus and techniques are required at this short wave length. A wave length of 380 mμ was selected as being the closest practical working point on the curve in the proximity of the second maximum. This wave length was used in preparing the calibration curve shown in Fig. 3, which covers the range from 2 to 80 ppm of sulfate ion.

The curve is linear, following Beer's Law between 20 and 80 ppm. Below 20 ppm the curve is concave upwards. It crosses the abscissa at 2 ppm sulfate ion concentration due to the slight solubility of barium sulfate in the salt acid solution. Above 80 ppm sulfate ion concentration the curve is concave downward and the optical density rapidly approaches a constant. The standard calibration curve (Fig. 3) does not include values above 80 ppm because they are difficult to reproduce accurately.

The calibration curve shown on

Table 1
DETERMINATION OF $SO_4^{=}$ IN STANDARD SULFATE SOLUTIONS
BY A (GRAVIMETRIC) AND B (TURBIDIMETRIC) METHODS

ppm $SO_4^{=}$ Standards [a]	5	5	10	10	20	20	30	30	40	40	50	50	60	60	70	70	80	80
Method*	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
ppm $SO_4^{=}$ found in [a] replicate samples	4.5	6.1	7.5	10.5	19.0	20.1	25.0	31.1	40.0	40.7	48.5	51.3	49.5	60.9	63.5	68.4	74.0	80.0
	4.5	6.0	8.0	10.2	18.5	21.0	28.5	29.6	39.5	40.1	48.0	48.9	48.0	60.8	63.5	68.7	72.5	79.5
	3.5	6.0	8.0	9.5	19.0	20.7	28.0	30.7	41.0	39.1	50.0	50.0	51.0	61.8	61.0	68.7	73.5	80.4
	5.5	6.0	4.5	10.2	16.5	19.7	29.5	29.4	38.5	39.6	50.0	51.3	52.0	60.9	63.5	69.8	70.0	79.2
	4.5	6.0	9.0	9.9	18.0	19.7	28.5	30.2	40.5	39.6	50.5	50.3	51.0	60.8	63.0	70.6	73.5	80.0
	3.5	5.3	8.5	8.8	20.0	20.6	25.0	30.7	39.5	39.7	49.5	50.1	56.0	61.5	65.5	70.3	74.0	80.6
	4.0	6.0	8.5	10.5	18.5	19.9	26.5	31.2	40.5	40.7	50.0	51.2	54.0	60.7	67.5	69.7	74.0	79.8
	2.5	6.1	7.5	10.5	18.0	19.7	28.0	29.2	40.5	40.6	49.5	51.3	51.0	61.5	68.0	70.4	73.5	80.3
	5.0	5.7	6.0	9.9	17.5	19.3	25.0	30.2	38.0	39.7	46.0	50.4	59.0	62.8	68.5	70.5	76.5	80.3
	....	6.2	6.0	10.0	19.5	19.6	25.5	30.7	39.0	39.6	47.0	50.1	58.0	61.1	66.0	69.4	77.0	79.4
Average	4.1$_7$	5.9$_4$	7.3$_2$	10.0$_0$	18.4$_5$	20.0$_2$	26.9$_5$	30.3$_0$	39.7$_0$	39.9$_4$	48.9$_0$	50.4$_0$	52.9$_5$	61.2$_8$	65.0$_0$	69.6$_0$	73.8$_5$	79.9$_8$
Standard Deviation±	.832	.245	1.341	.504	.961	.527	.851	.669	1.362	.530	1.410	.746	3.48	6.16	2.390	.778	1.850	.443
Coef. of Variation %	20.00	4.12	18.23	5.00	5.21	2.63	3.16	2.21	3.43	1.33	2.88	1.48	6.57	1.01	3.68	1.12	2.51	0.55

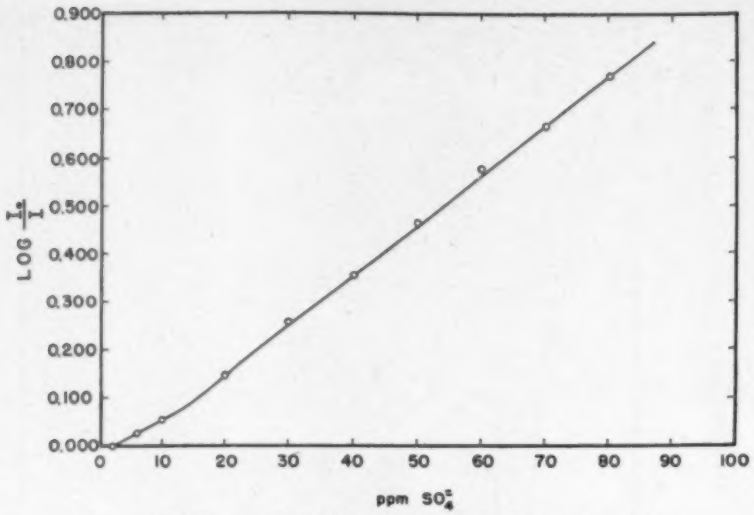


Fig. 3—STANDARD CURVE for turbidimetric sulfate determination
Beckman Spectrophotometer, Model DU, with cells having 1-cm light path.

Fig. 4 was constructed using a 425 mμ filter on a Fisher electrophotometer. A comparison of the shape of this curve with the curve obtained using the Beckman Spectrophotometer shows the expected similarity.

Evaluation of Results

To evaluate the method, standard potassium sulfate solutions were prepared in sufficient quantities to allow replicate analyses (10 samples for each concentration) to be run by both the gravimetric[3] and the turbidimetric method. The concentrations prepared with respect to sulfate ion were 2, 5, 6, 10, 20, 30, 40, 50, 60, 70, 80 ppm. A comparison of the results of the two methods combined with a statistical analysis is shown in Table 1.

To appraise the method with respect to field samples, six typical water samples were run by both methods in ten replications. These samples included two well waters and four tap waters from different sources: Richmond, San Francisco, San Rafael and the California Water Co. A comparison of the results, including a statistical analysis, is shown in Table 2.

Discussion

One of the most difficult aspects of turbidimetry is the formation of reproducible dispersions. As variations in particle size cause the greatest fluctuations in turbidity measurements, emphasis is placed on the formation of particles of the same relative magnitude. In addition, the particles must be sufficiently fine so as not to settle rapidly; but the particles must not be colloidal, because colloidal solutions have interfering optical properties. The formation of optimum size particles is accomplished in the proposed turbidimetric sulfate method by carefully observing the prescribed conditions of the procedure.

The following conditions have been taken into consideration in the procedure in order to produce suspensions of a uniform physical character: the concentrations and ratio of concentrations of the barium and sulfate ions; the manner and order of mixing; the time rate of mixing; the amount of salt and acid present; and the temperature.

To produce and keep a suspension for the time necessary to make the turbidity measurement, the sulfate ion concentration must not exceed 80 mg per liter. It is also necessary to control the rate of precipitation. This is accomplished by adding solid barium chloride of a definite grain size (20-30 mesh). Thus the rate of solution of the barium chloride controls the rate of the reaction between the barium and sulfate ion.

In addition to sulfate ions, carbonate, chromate, phosphate, and oxalate ions also form precipitates with barium ion. Interference from these latter four anions can be eliminated by allowing the reaction to proceed in a dilute acid solution.

The acid used to form the dilute acid solution causes an increase in the solubility of barium sulfate. It has been shown that sodium chloride also causes an increase in the solubility of barium sulfate[4]. Therefore, the addition of hydrochloric acid and sodium chloride to the solution containing sulfate ion, *prior to the addition of barium ion*, inhibits the ultimate growth of micro crystals of barium sulfate, which is desirable.

Precision and Accuracy

The results of replicate analyses of standard sulfate solutions by both the gravimetric and turbidimetric method are shown in Table 1. The concentrations range from 5 ppm to 80 ppm sulfate ion. It is not feasible to go below this lower limit for either method without concentrating the solution because the gravimetric method presents the problem of accurately weighing minute quantities of precipitate, and in the turbidimetric method the barium sulfate is completely soluble in the salt-acid solution at low concentrations (approximately 2 ppm sulfate ion and below). The reason for settling the upper limit at 80 ppm sulfate ion in the turbidimetric method has been previously mentioned, but no difficulties are encountered by accurately diluting more concentrated solutions until they fall within the specified limits. The gravimetric method has no distinct upper limit.

A statistical analysis of the replicate results (Table 1) shows that the turbidimetric method has a slightly greater precision and accuracy than the gravimetric method in the range studied.

Table 2
DETERMINATION OF $SO_4^{=}$ IN TYPICAL LABORATORY SAMPLES
BY A (GRAVIMETRIC) AND B (TURBIDIMETRIC) METHODS

Typical Sanitary Laboratory Sample	Richmond Tap Water 10/5		Well Water 30'		Well Water 90'		Calif. Water Company 11/29		San Fran. Tap 11/18		San Raphael Tap 11/19	
Method	A	B	A	B	A	B	A	B	A	B	A	B
ppm $SO_4^{=}$ found in replicate samples	32.4	38.4	126	118	103	106	59.2	59.0	8.0	10.8	5.6	6.2
	30.4	38.2	125	117	101	107	58.0	57.0	7.6	10.4	6.0	6.0
	31.6	40.6	127	117	104	103	58.0	59.0	8.4	10.4	5.6	6.1
	32.4	37.0	126	116	104	106	60.0	57.5	8.4	10.6	6.4	6.4
	34.4	38.0	127	116	103	106	58.8	59.5	8.4	10.8	6.0	6.2
	32.4	39.2	126	116	103	101	59.2	56.5	8.4	10.6	4.8	6.4
	33.2	38.1	127	116	101	106	58.8	62.0	8.0	10.0	5.6	6.0
	33.6	39.1	126	118	101	103	57.6	63.0	7.6	10.2	6.0	5.6
	31.6	37.6	125	116	102	108	56.4	58.0	8.8	9.8	5.6	5.0
	33.6	39.6	126	116	103	103	58.4	59.0	9.2	9.8	6.0	6.2
Average	32.5_0	38.5_8	126_1	116_6	102_5	104_9	58.4_4	59.0_5	8.2_8	10.3_4	5.7_6	6.0_1
Standard Deviation ±	1.118	.999	.71	.775	1.096	2.12	.955	1.968	.475	.358	.407	.401
Coef. of Variation %	3.43	2.59	.56	.66	1.07	2.07	1.63	3.33	5.73	3.46	7.07	6.67

The apparent lack of precision and accuracy in the gravimetric method is in agreement with recent findings[7] obtained with the electron microscope in the examination of barium sulfate crystals. Crystal size was compared to filter paper pore size and it was concluded that a sulfate molarity of 0.006 (30 ppm) is an approximate minimum for gravimetric determinations.

When a statistical comparison of the results is made on field samples (see Table 2), the same approximate degree of precision is found for both methods and is roughly of the same order of magnitude as found in standard samples of corresponding value.

The ease of determining the sulfate ion concentration by the turbidimetric method offers an advantage that is immediately apparent: the sulfate ion concentration of a field sample can be determined within ten minutes after the sample has been received by the laboratory. In addition, it has been found that even an unskilled laboratory worker can analyze ten samples an hour for sulfate ion concentration, with a high degree of precision and accuracy.

The similarity in shape of the standard calibration curves obtained using both the Fisher and Beckman Photometers indicates that results obtained on different instruments operating at different wave lengths are equally reliable.

The anions and cations generally found in sanitary laboratory samples offer no interference in the turbidimetric method when the specified procedure is adhered to.

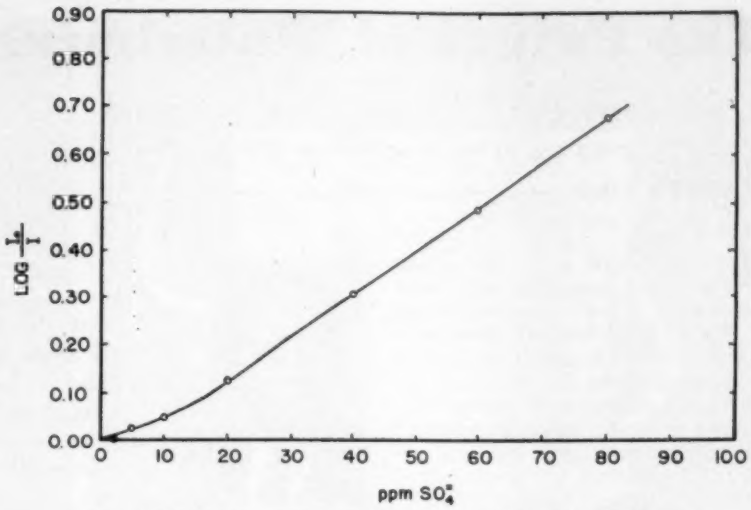


Fig. 4—STANDARD CURVE for turbidimetric sulfate determination
Fisher Electrophotometer, with circular cells having 2-cm light path.

Conclusions

The analytical method described in this paper is applicable to the determination of sulfate ion in most water samples encountered in the sanitary laboratory. The precision and accuracy of the method, in the range between 2 and 80 ppm sulfate ion, are greater than that of the gravimetric method. In addition, the method has the added advantage of speed and simplicity.

Acknowledgments

Acknowledgment is made of advice and assistance given by W. F. Langelier, Professor of Sanitary Engineering, and Professors H. B. Gotaas and P. H. McGauhey, Director and Assistant Director, respectively, of the Sanitary Engineering Research Laboratories.

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Paul D. Haney Joins Black & Veatch

Black & Veatch, consulting engineers of Kansas City, Mo., have announced that Paul D. Haney has joined their staff and will be active in matters pertaining to water supply, water purification, sewage and waste disposal, and other sanitary problems.

Mr. Haney was, until recently, Sanitary Engineer Director at the Robert A. Taft Sanitary Engineering Center, U.S.P.H.S., Cincinnati, Ohio. Prior to his service at Cincinnati, he was professor of Sanitary Engineering at the University of North Carolina, and previously he was an engineer with the Kansas State Board of Health.

V. W. Langworthy Joins B-I-F Industries

Omega Machine Co. Division of B-I-F Industries takes pleasure in announcing that Virgil W. Langworthy has joined their staff as a project engineer on September 20th, and will make Providence, R. I., his headquarters. As his principal duties he will further the advancement and applications of Omega and B-I-F Industries equipment in the waterworks field.

Mr. Langworthy comes to Omega from The Chlorine Institute, Inc., New York, and has a wide experience in sanitation. He is a graduate of Michigan State College and a member of AWWA, NYS&IWA, ACS and APHA. His prior experience includes serving as superintendent of the water softening plant at Adrian, Mich., and operator at the Lansing, Mich., softening plant.

The Future of Waterborne Wastes

A concise statement of the problem man has created and of his progress in learning to live with it

by HARRY A. FABER

A NEW LOOK at an old subject can reveal surprising and useful facts. The subject of waterborne wastes has been discussed from many points of view: in popular articles, in political speeches, in legislative actions, and in technical publications. What new aspects can be considered? Let us here investigate and illustrate the cyclic nature of waterborne wastes.

Mr. Faber is Managing Editor of *Water & Sewage Works*. His paper was presented at a recent meeting of the Association of Consulting Chemists and Chemical Engineers in New York City. It constitutes a summary statement designed to evaluate somewhat unusual considerations involved in the past, present and future of industrial wastes.

Pattern of Growth

There is a growth pattern or cycle similar for almost all organisms, whether a group of yeast cells or fruit flies, or the human beings comprising a nation[1]. Figs. 1 and 2 illustrate the typical population growth curves characteristic of yeast cells and of fruit flies. It seems quite logical that this pattern should be true of yeast cells or fruit flies, as a balance must exist between living space, growth-inhibiting waste products, and the limit of population which can develop. But it is significant that the same pattern of growth applies to human populations.

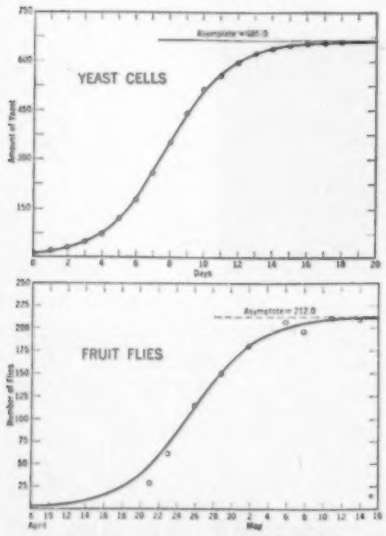
Fig. 3 illustrates the past, present, and future population growth curve of the United States. While it is true that a new cycle of growth may occur in a nation through re-organized resources or changed environment, evolutionary shifts in the population growth curve merely move the base and then the process goes on as before.

What can we learn from population growth curves? For our present purpose, we can consider living space and growth-inhibiting waste products to be the principal limiting factors in the development of human populations. We may logically assume these two factors to be practically identical. The waste products of man were of little significance until they were made so by his concentrations of population.

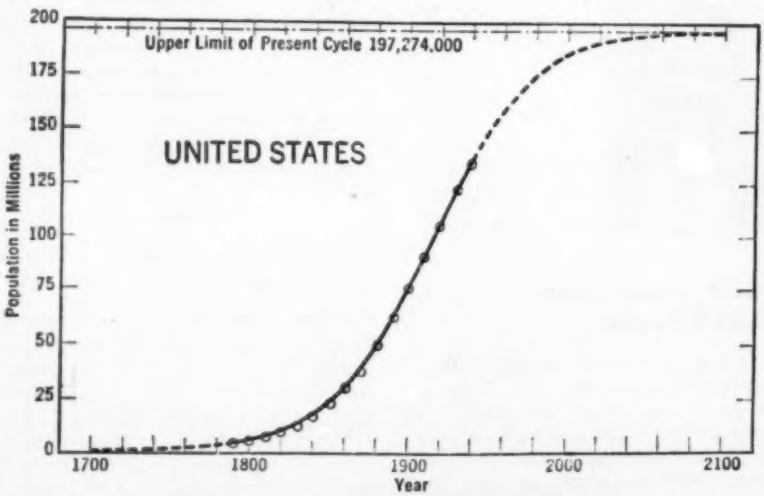
Water Needs of Man

Man needs water, food, and air in order to survive. With a small population, these needs present no great problem; but with growing populations, man must learn more and more to control his environment. This country's population has more than doubled during the past half century[2]. Current estimates indicate that during 1975 it will approach the 200 million mark. As a result of the growth and concentration of population, and of the expansion of this country's industrial capacity, the problems of water supply and of waterborne waste disposal will be intensified. The U.S. demand for water is illustrated in Fig. 4, and Fig. 5 compares water demand with supply.

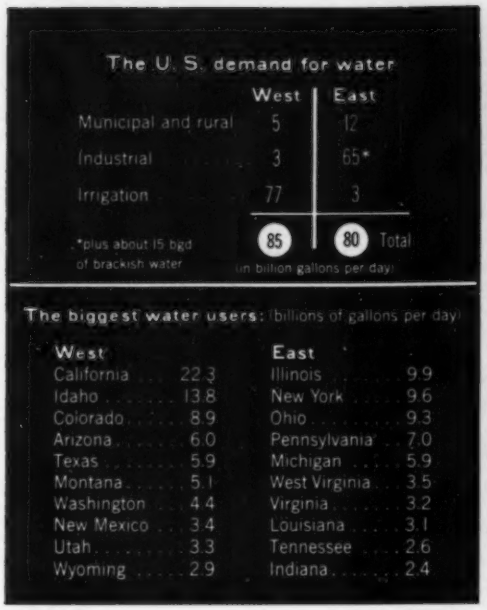
The problem of disposal or utilization of added volumes of both industrial and municipal wastes is a staggering one. When the demands that will be made upon our water resources are considered, it is clear that

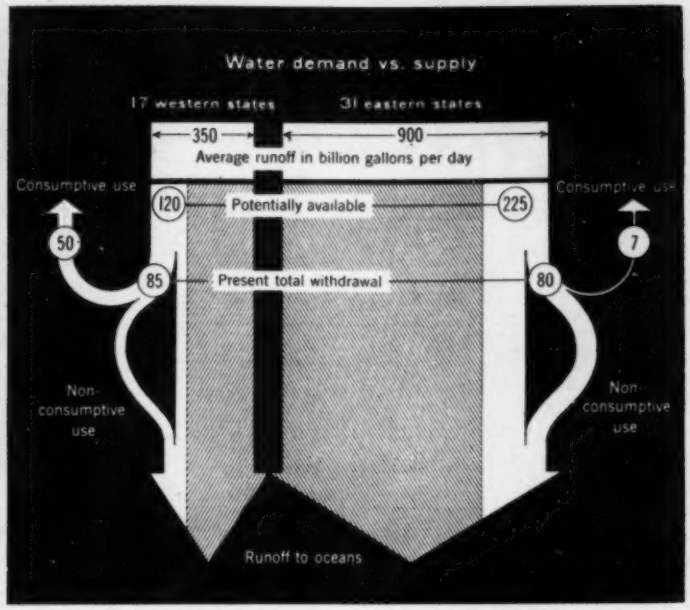


TYPICAL population growth curves
Fig. 1—Yeast cells. Fig. 2—Fruit flies.



GROWTH curves of human populations are similar
Fig. 3—Past, present and future population of the U. S.





WATER demand and supply in the United States *Fortune Magazine*

Fig. 4—Present water requirements. Fig. 5—Water demand compared with water supply.

this nation cannot afford to discharge these wastes untreated into streams. The inevitable reduction in usable water supplies which would result could not be tolerated. Water supply and the disposal of waterborne wastes are closely integrated, as illustrated in Fig. 6.

Water requirements of the U. S. in 1975 are expected to be almost double our present needs, and to use as much as 90 per cent of all the water that can be developed at reasonable cost. Industry's needs alone may increase 170 per cent, from 80 billion gallons per day to 215 billion gallons. Municipal needs should increase 50 per cent, partly due to increased population and partly to intensified use of modern appliances.

Waste Water Problem

The municipal and industrial uses of water are essentially "non-consumptive" uses. That is, over 90 per cent of the water so used is discharged as the carrier of man's waterborne waste. This use of water to carry and to finally dispose of liquid waste is an essential one. Large communities and industries could not exist if streams or tidewater were not available to carry away their waste water. It is right and proper that man and industry should use the streams nature has provided to dispose of wastes, but difficult problems arise when a stream is called upon to assimilate a volume of waste that exceeds its capacity for self-purification.

Just as the pattern of water use shows an increasing rate of growth, so does the pattern of stream pollution. For the growing municipal and industrial consumption of water is immediately reflected in a growing volume of waterborne wastes. But the volume of this nation's streams remains the same — and the streams have only a fixed capacity for natural purification of wastes. And as streams become overloaded with pollutants, the water becomes unfit for other uses.

Only about twenty years ago did the general public become aware of stream pollution as a real and serious problem, and only in the last six years have expenditures in the sewage and industrial waste treatment field grown significantly. The sewage field expenditures during the years 1948 to 1953 were respectively 436, 484, 502, 544, 535, and 678 million dollars, as illustrated in Fig. 7. While the municipal investment in sewage treatment works is over 5 billion dollars, it is estimated that cities and industries will have to spend about 10 billion dollars over the next ten years to clean up the nation's streams.

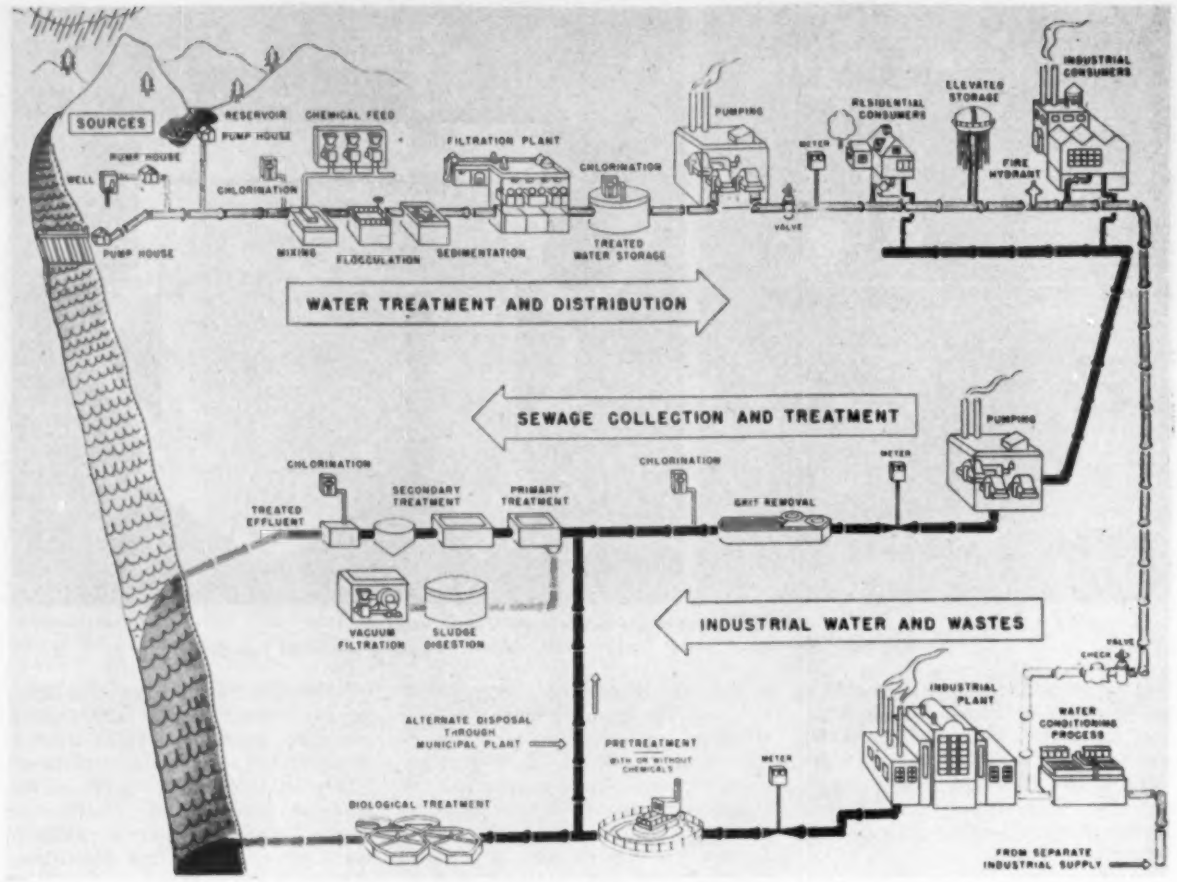
The municipal and industrial pollution load on U. S. rivers and streams is not completely measured. The record shows[3] that, based only on oxygen depletion, municipal pollution is now equivalent to the wastes from a population of 65 million; known industrial pollution is equivalent to wastes from a population of 45 million; and estimated industrial pollution is equivalent to wastes from a population of 40 million. These data are illustrated in Fig. 8.

There are 11,800 municipalities having sewers: of these 3,500 provide adequate treatment; 3,100 partial treatment; and 5,200 no treatment. There are 10,400 industrial plants discharging wastes; 2,600 of these are treating their wastes; in 4,100 of these treatment has not been determined; and in 3,700 of these no treatment is provided. Remember, these data are based only on oxygen depletion evaluation of the waste load. In addition, the rivers also carry brines, acid wastes, and the great variety of substances (some of which may be toxic) whose effects are unknown. Stream pollution now has become a national problem. Its pattern of growth is similar to other cyclic curves.

Most public health authorities agree that it is uneconomic and unreasonable to require the treatment of all wastes. The purpose of treatment is to meet the broad public interest, that is, to keep a stream from growing so polluted that it can no longer serve the legitimate needs of neighboring towns and industries.

Waste Reduction and Treatment

Stream pollution laws are needed and they should be enforced equitably. The conservation of natural resources transcends the mathematics of economics. Hedgepeth[4] emphasizes that, "In stream pollution control we are dealing with the wise use of a renewable resource, as opposed to its abuse. If the receiving stream cannot healthily assimilate the wastes



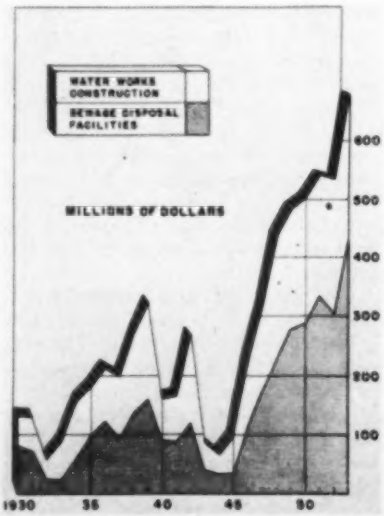
INTEGRATION of water supply and waste disposal

Fig. 6—Flow diagram illustrating typical relation between water, sewage, and industrial wastes.

from a new industrial plant, the plant should be located elsewhere."

The original—and still predominant—approach to the solution of industrial waste problems is on the basis of municipal sewage treatment processes. This solution is far from satisfactory. Aside from the fact that both wastes are waterborne, there is little in common between domestic sewage and industrial waste waters. There are many industrial waste problems which cannot be solved by the application of presently known treatment methods. Real stream pollution abatement must begin closer to the roots of the problem, since the evils actually begin in the research laboratory, at the conference table, on the flow sheet, on the drafting board, and in the operations control office.

Industry's pollution problems must be faced realistically. Hedgepeth points out[5] that "The appropriation of capital to finance waste treatment projects must be in competition with productive investments." Recognition of this fact emphasizes the primary need of industry to appraise waterborne wastes from a chemical and chemical engineering point of view. It will be good business to do so. The volume and concentration of waterborne wastes may be reduced, certain "problem" wastes may be eliminated or receive separate treatment, and some problems may be solved by the profitable recovery of by-products. Recovery, pretreatment, or elimination of waterborne wastes is not the job of sanitary engineers, but must be that of chemists and chemical engineers having special knowledge of a specific manufacturing process.



EXPENDITURES for construction

Fig. 7—Growth of water works and sewage disposal facilities.

Effluent Disposal and Reclamation

Following the treatment of a waterborne waste, there still remains the problem of effluent disposal or reclamation[6]. For "disposal" the waste must be so treated that it is suitable for discharge to a stream, lake, or ocean, or upon the ground in accordance with accepted health, nuisance, and pollution standards. For "reclamation" the waste must be so treated as to produce an effluent suitable for re-use.

Water reclamation may be either incidental, planned, or integrated as illustrated in Fig. 9. Incidental water reclamation is accomplished whenever waterborne waste effluents are disposed of to streams or to land.

Planned reclamation is based on using the optimum treatment process designed to provide an effluent suitable for a predetermined use. Integrated reclamation involves the management of treatment and reclamation processes to the end that waterborne waste effluents may be available for maximum re-use at minimum cost.

There are problems of quality and of economy relating to the re-use of effluents. Health limitations dictate that only crops not utilized directly as food may be irrigated with primary-treated sewage effluents. For unrestricted crop use, effluents must be well-oxidized and disinfected—to the degree that they meet essentially the same standards as potable water.

In evaluating the cost differential between natural and reclaimed water supplies, only those charges in excess of disposal costs should be assessed against the final user. At Baltimore, for example, the Bethlehem Steel Co. uses effluent from the municipal sewage treatment plant in its steel production. The effluent provides a return to the city and, at the same time, its cost to the industry is less than that of other resources.

Many industries are learning to re-use process and cooling waters within their own plants, thus following integrated reclamation and disposal practices which are to their economic advantage. One such instance is that of the new Lever Brothers plant at Los Angeles. Initial estimates indicated that the wasted effluent would total 20 to 30 mgd. Proper engineering design, however, resulted in the discharge of less than 1.0 mgd from this large plant (cost $25 million).

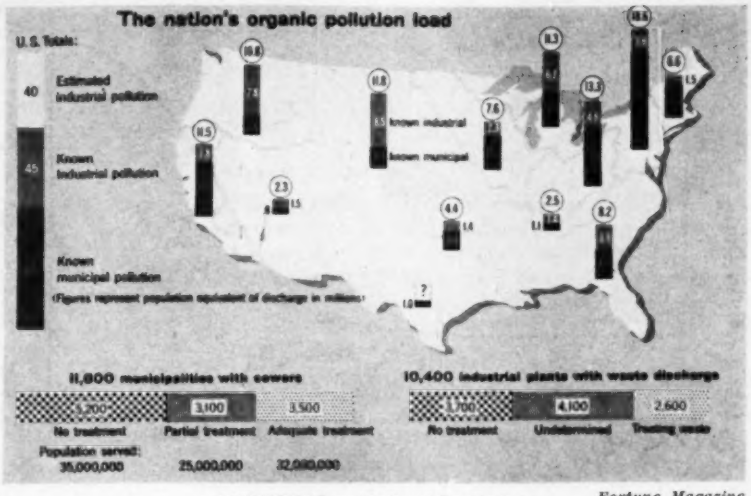


Fig. 8—U. S. pollution load, based on oxygen depletion.

There are several areas of research that obviously are of major and primary importance[2]. New techniques must be developed for determining the amounts and kinds of pollution and their effects. Methods for treating new industrial wastes must be developed. Specialized personnel and the coordination of research is vital to future progress. We need a deeper appreciation of the multiple-purpose concept of water use, and we need to apply that concept.

We can make a surprisingly accurate prediction of population growth; to predict the endless ways in which man can change and complicate his environment is beyond our grasp. It may be, however, that an actual cycle of pollution growth can be plotted when sufficient data becomes available. If this proves to be possible, a pattern of growth may exist which directly relates the "effect of growth-inhibiting waste products" to the growth cycle of human populations. The author has theoretically illustrated this condition in Fig. 10.

The farther man has moved away from the balanced integration of nature, the more his physical environment has become harmful. Neutra[8] has stated this clearly. "Man may perish from his own explosive and insidious inventions. For an adjustment to them, he leaves himself precious little time, and progressively less as his technological wizardry runs

New Waste Treatment Problems

The future is sure to bring many new industrial products and new waste problems. Twenty-five years ago, for example, detergents, insecticides (DDT and Benzene hexachloride), plastics, and a herbicide (2, 4-D) were chemicals of no importance. They now are produced by the millions of pounds, and their production is increasing rapidly. Similarly, we have new waterborne wastes from the growing antibiotic industry.

Waterborne wastes which contain radioactive materials have created entirely new problems of disposal: treatment methods devised to date are uncertain and not particularly promising. In the future, we must deal with mounting quantities of atomic wastes. These wastes differ from anything previously produced by man because they are, by our measures, nearly eternal[7].

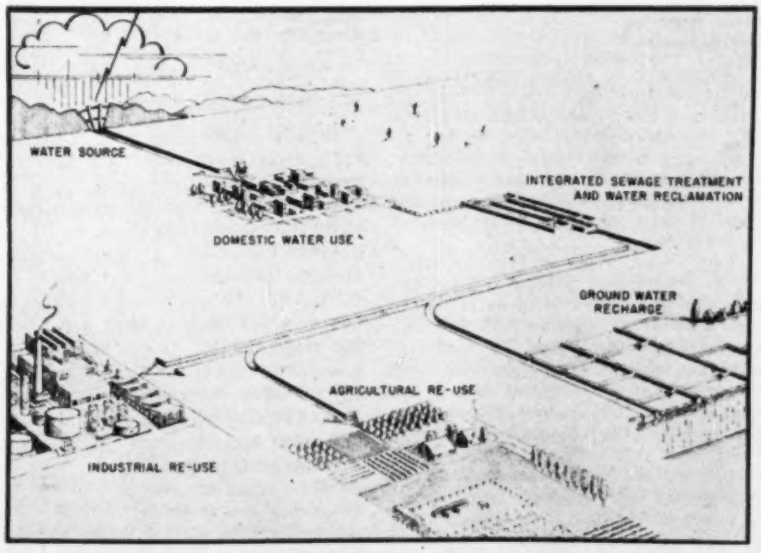
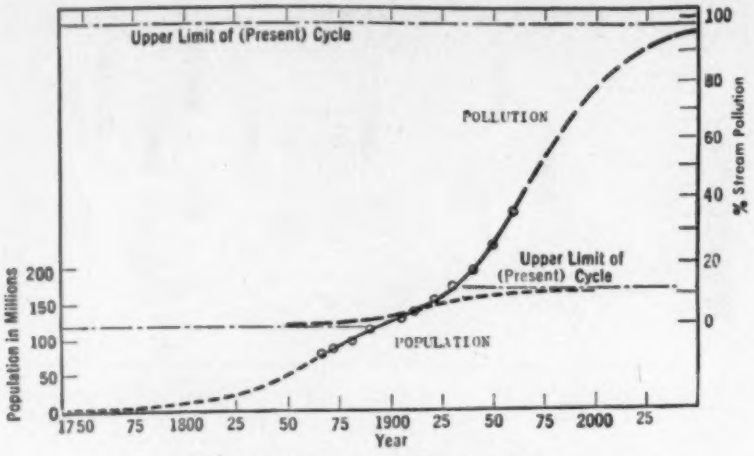


Fig. 9—The re-use possibilities of treated sewage effluents.



CYCLES of U. S. population and pollution

Fig. 10—Growth pattern of stream pollution, a theoretical cycle.

wild and rushes on. If he is to survive at all, it cannot be through slow adjustment. It will have to be through design more subtly considered and circumspect, through more cautious planning in advance."

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W&SW

What It Costs to Properly Water a Lawn

A boost to water use appears in Scott's *"Lawn Care,"* a useful and widely-circulated free publication of O. M. Scott & Sons, growers and distributors of high grade grass seeds of Marysville, Ohio.

The following is taken from Scott's *"Lawn Care,"* No. 128, and should interest water works men for the reason that it is calculated to increase water use for producing better lawns and also for the interesting comparison of lawn watering costs in various cities and different sections of the country.

Lawn Watering Not Expensive

"To be able to answer inquiries as to the cost of watering lawns, we conducted a survey of water rates in different places. Our conclusion is that watering for the lawn is not costly. Where it is available, the generous use of water on the lawn can give more satisfaction in appearance and comfort than most any other summer expenditure.

"Lawn Care holds no brief for water companies, public or private. But few who complain about the cost of water stop to consider that it's 'cheaper than dirt'. In a typical city, 1000 gallons is delivered wherever it is wanted for less than 50c. Amounts over the minimum drop to less than 25c per 1000 gallons. For instance our own town has what seems a very high rate. Even so, a large lawn of 10,000 square feet can have the equivalent of an inch of rain every week for three months at a cost of less than forty dollars.

"The accompanying table embraces typical rates that should enable you to estimate the cost of a dry summer's watering of your lawn—based on your local rate schedule."

City	Quarterly Minimum	Over Minimum Per 1000 gal	Over Minimum 10 ins water on 1000 sq ft
Wellesley, Mass.	$2.40	$0.29	$1.82
New Haven, Conn.	3.00	0.26	1.63
Suburban N. Y. C.	4.50	0.40	2.50
Philadelphia	2.65	0.09	0.56
Washington, D. C.	2.75	0.18	1.13
Charlotte, N. C.	2.50	0.26	1.63
Altoona, Penna.	2.50	0.26	1.63
Pittsburgh	3.40	0.34	2.13
Cleveland, Ohio	1.50	0.10	0.63
Columbus	5.10	0.23	1.44
Cincinnati	2.00	0.13	0.81
Detroit	1.64	0.10	0.63
Indianapolis	5.10	0.32	2.00
South Bend	3.00	0.24	1.50
Evansville	3.75	0.20	1.25
Winnetka, Ill.	2.50	0.28	1.75
Springfield, Ill.	1.50	0.17	1.06
St. Louis	2.25	0.20	1.25
Rochester, Minn.	4.00	0.20	1.25
Des Moines, Iowa	2.00	0.26	1.63
Omaha, Nebraska	3.00	0.19	1.19
Kansas City, Mo.	1.98	0.29	1.83
Kansas City[1]	5.25	0.37	2.32
Wichita, Kansas	3.90	0.42	2.63

[1]K. C. Suburban Water Co.

It is of interest to note from the table that lawn watering is most expensive in Suburban N. Y. City, Wichita, Kan., and Suburban Kansas City; least expensive in Philadelphia, Cleveland, Detroit and Cincinnati. Because of "flat rates" in N. Y. City, Denver, and Chicago no costs for lawn watering are given for these cities. Good reason — it costs the user nothing to water lawns when meters are lacking; it costs the city plenty.

In this same issue of *"Lawn Care"* the following appears:

"Most lawns are just as well watered one time of day as another. The idea that it is bad to water grass in the hot sun bobs up repeatedly. Actually mid-day is a good time to water because it tends to cool the soil and the grass plants."

About Sewage Disposal on Cleveland's Water Intake Crib

In our June, 1954, issue appeared an article captioned "Water Intake Crib is Lonely Island." This article related the life of the keepers of the Cleveland (Ohio) water intake crib, which is located out in Lake Erie far removed from the shore.

Some of our readers have raised the question as to the method of sewage disposal on this water supply intake crib. To answer the question, we have called upon Frank J. Schwemler, Cleveland's Commissioner of Water, to assist us. The following is taken from his reply.

"Our maintenance force (crib keepers) operates the crib light, fog horn, radio and weather reporting equipment only during the navigation season—March to October. During the winter period the crib is closed, and locked, and the keepers are rewarded with a vacation or over-time leave. During the period of occupancy all sewage and garbage is disposed of through use of a chemical toilet tank which is emptied weekly (more often if need be) and taken by boat to a point two miles distant from the crib. It is there discharged into the lake in the same manner as is sewage and refuse from ships which ply the lakes in navigation season."

Realization that many readers have wondered what disposition is made of refuse and sewage on "Cleveland's Lonely Island" prompts us to publish this sequel to the story that appeared in our June issue.

Thoughts on Sewage Works Equipment

An Open Letter From One Sewage Works Operator to Another

Dear Bill,

This is the month of the Federation Meeting in Cincinnati. I was glad to learn from your recent letter that you'll be there. Since this will be your first one, I'll be interested to learn what you think about these meetings. For myself, I always like to attend the Federation conventions. I like to meet old friends; I like to make new ones; I like to talk over mutual problems with both. I like to listen to the technical papers, although sometimes they are over my head or don't apply to my particular problems and activities. The "Operator's Forums," however, are right down my alley. Then, I certainly like to visit the equipment manufacturers' exhibit booths. It's there that I look forward to seeing new solutions to old problems; new ideas for handling sewage, sludge, chemicals; new devices for measuring flow; and so on. And, it's there that I meet up with a lot of old friends, too.

You know, when you come right down to it, in this business of ours, equipment is mighty important. It's important for what it can and does do. While we talk glibly about the chemistry and biology of sewage treatment, an awful lot of today's treatment involves mechanical equipment.

While the "bugs" and the chemicals carry on the various processes of treatment, we have to provide them with a place to work as well as moving the sewage and its products and byproducts from here to there. And that's where the equipment comes in.

About Buying

When it comes to equipment, it's important that what you buy is good, that it will do the job you want it to, that it will stand up under the load imposed on it, and that, with good care, it will last a long time. I always feel that equipment manufacturers who are Associate Members of the Federation and stage exhibits at the annual meeting can be trusted to produce equipment that is good and will do the job, as well as last for some time. That doesn't mean that I just pick up the phone, call a manufacturer and say, "Send me such-and-such." I don't! And, I don't shop around, looking for the lowest price, either. You can get mighty burned just buying on price. Some taxpayers seem to think that the City should always take bids, and purchase from the lowest bidder. These same men in *their* business do not buy on price alone.

For big jobs, of course, I actually write specifications, setting forth pretty much in detail, just what I want and just what I expect the equipment to do, how big it shall be, how well or how accurate it shall perform, and so forth. Even on smaller equipment items, I tell the salesman just what I want in the way of performance, etc.

When I chose the equipment, I try to evaluate the price against what I want it to do and how well it will stand up, and I don't always buy the cheapest item. Sometimes when you consider everything: maintenance, operating cost, life expectancy, and so forth, you get more for your money by paying more for the equipment. Of course, everything being equal, I'm pretty human and like everyone else, I lean toward a friend's equipment; but by gosh, I don't let mere friendship sell me something that will do the job when I feel I can get something better, or something about equal, at a better price.

Preventive Maintenance

There's another important thing about the long term cost of equipment. That's to keep it in good shape so it can continue to perform properly for a long time. That's where preventive maintenance comes in. It's just like taking care of your automobile or your house and the mechanical equipment in the modern home. I know one manufacturer who has issued a handy reference sheet that in a short space, sums up the whole philosophy and rules for good preventive maintenance. It's a good presentation of how to avoid costly breakdowns and there are a lot of good ideas in it. This useful reference sheet points out that one of the first steps in preventive maintenance is to know the equipment. The equipment manufacturer's instruction manual will take care of that. Not only should you read it, but you ought to file it away, where you can find it when you need it. By going to conventions, a plant operator has the opportunity to learn a lot about equipment in his plant by visiting the manufacturer's exhibits and asking questions.

Also, when it comes to proper maintenance, you need the proper tools and the proper spare parts. It's a good idea to ask the manufacturer how much and what kind of each you need, then keep them in a special place where you can always find them.

When any new equipment is started up it is well to promptly set up a preventive maintenance schedule and develop a card file or record system to keep track of what should be done and when. Here are some of the things on which I've set up a preventive maintenance schedule: Valves, both plug and gate, as well as sluice gates; pumps (sewage, sludge and chemical); portable equipment such as trucks, welders, tractors, etc.; chemical feeders, screens and screening grinders, and so on. In fact, we have a preventive maintenance schedule and maintenance record on every piece of electrical and mechanical equipment in the plant. In many cases, this preventive maintenance schedule is simply regular and proper lubrication. A few years ago *Water & Sewage Works* published a lubrication check chart that has also been reproduced in the annual Reference Edition of this magazine. It can give you some good ideas both on lubrication, and how to set up a preventive maintenance schedule.

When it comes to finer equipment like metering and control instruments, if you don't have a skilled mechanic who can be taught this type of service, there is something else you can do. You can hire a regular Maintenance Service from some of the manufacturers of this type of equipment. For a relatively low charge, you can benefit from the skilled maintenance and checking at regular intervals by a factory trained service man. These companies have worked out this scheme very nicely. They put you on a "circuit" and you pay only for the prorated travel expenses plus a small regular fee for the actual service. You can arrange for once a year service or for twice a year service. Whatever it costs, it's good insurance and believe me it's worth it.

Looking forward to seeing you at the Federation Convention, I am

Yours, Fred

THE EDITOR'S COMMENTS

More Babies — More Water Needed

At this time, when water demands have been increasing at rates heretofore not anticipated, when employing the now outmoded per capita demand as the basis for planning water needs of future years, it seems doubly important to consider an additional demand factor appearing in the current news of the day.

Almost daily now, the press and other news sources reminds us that the present "Baby Boom is Bursting All Birth Rates." Another head-line heralds "More Babies —More Business!" Looking at statistics, the U. S. Public Health Service reports that 1,291,000 new babies were added to the present population during the first four months of 1954. This birth rate represents an increase of 30,000 more babies born during the first four months of this year than were born in the same period of last year.

Another statistical report tells us that since 1940 the number of children under five years of age has increased by 7,000,000. Already, with over-crowded schools it is predicted that by 1960 the public school enrollment will be 35% higher than in 1950. When these children marry, and begin raising families, no telling what the increased birth rate will be.

What does all of this mean to the water supply and sewage disposal field? It means more homes to be built, more water to supply these homes; and more sewage collection and treatment facilities required to serve these new homes and families.

So water and sewage works men have to consider more than normal anticipated population growth during the years ahead in planning water supply and sewage disposal needs. It all adds up to an additional demand growth curve to be super-imposed on those additional demand curves created in recent years by the newer demands for water in the home—air cooling, automatic dish and clothes washing machines, more automobiles to be washed, more lawns and gardens to sprinkle or irrigate, more babies to bathe, more children to waste water, more money to pay water bills without worry about use, or even waste; and, too, the added fact that water rates have not gone up in line with the decreasing value of the dollar.

We could possibly throw in other factors which bid fair to increase the slope of the curve for per capita water demands in the years ahead. Almost everyone has been taught by water works men that "Water is Cheaper than Dirt"; and, the general public is treating it just about that way. For instance, that "minimum rate" bill which permits the use (or waste) of a certain number of cubic feet or gallons of water during the billing period comprises a dis-service to the water works industry. By this method of charging for metered water, wasting of water is actually promoted. An illustration of this is found in the many cases wherein the water bill is always the minimum bill. In such cases the customer has absolutely no encouragement from the water utility to conserve water.

Well, we have diverged somewhat from the basic consideration of this editorial commentary, but now return to say—watch out for that additional demand curve in future water supply requirements, which the spectacular "Baby Boom" of today is to create in addition to the ever increasing per capita demand for water which modern household conveniences have created.

Fluoridation Upheld by Court in Milwaukee Test Case

What is believed to be the first legal test of the rights of a water utility to add fluorides to a public water supply has been decided by the Circuit Court of Wisconsin in favor of the City of Milwaukee and the Milwaukee Water Department.

On April 7, 1953, the people of Milwaukee voted for water fluoridation. After a number of stormy sessions, the City Council voted to adopt fluoride treatment of the water supply to benefit the teeth of Milwaukee's children. Fluoridation was started a few months later, whereupon a suit was filed against the city by seven taxpayers, claiming that fluoride treatment comprised enforced medication and therefore was unconstitutional. Hearings before Judge Ronald A. Drechsler of the State Circuit Court of Wisconsin began on April 29th.

In his recent decision, Judge Drechsler states that the Court finds the addition of fluorides to a public water supply is a legal and proper use of a city's police powers. He said, "Without any substantial dispute, it appears from all evidence weighed that facts exist to justify the regulation in question (fluoridation) . . ." He also noted that the act constituted "reasonableness of action," and no actual taking of property or private rights exists, even though some degree of compulsion, due to the monopolistic aspects of public water supply, does exist.

In matters involving the promotion or protection of the public health, the Court finds that: "the people as a whole may be required to do, or not do, certain things which fall within the exercise of the police powers of the City or State." Police powers, involving imposition of such restraints, "is not an invasion of those liberties guaranteed by the federal or state constitutions."

As to the plaintiff's collective complaints that fluoridation constituted "mass medication," the Court held that "water fluoridation does not comprise medicine or pharmacy," and implied that it constituted "preventive medicine" or "preventive dentistry" if anything of that nature applied, as it does in the case of water chlorination for protection of public health.

As to the complaint that enforced medication violated the freedom of certain religious rights, the Court stated that: "Regulations (as in this case) enforced for the protection of society and the public health are essentially civil and not religious."

It seems doubtful, in the face of the evidence presented by medical, dental and public health authorities, in comparison with that of the plaintiffs, that the decision of Wisconsin's Circuit Court will be appealed to the State's Supreme Court. For the present, at least, the legality and constitutionality of water fluoridation has been established in its first test case before a state court.

L. H. Enslow

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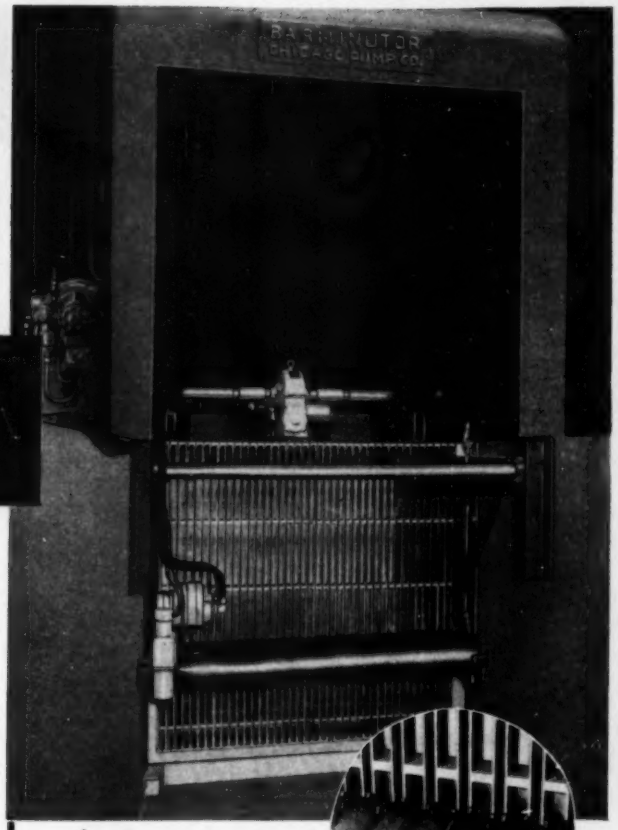

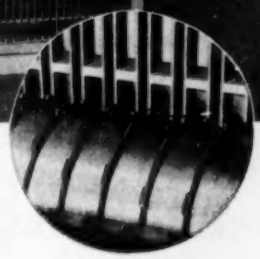

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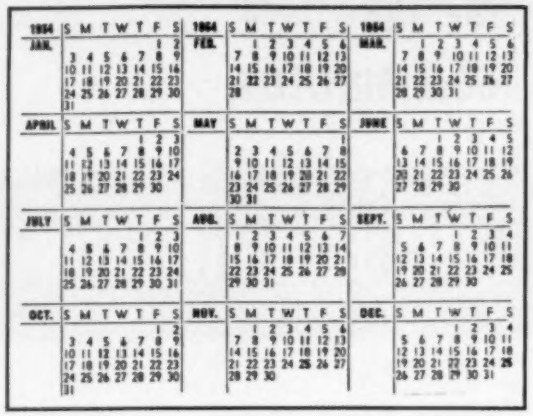

Oct. 11-14—Cincinnati, O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N. Y. *(Statler Hotel*—Tech. Sessions, *Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting.) Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N. Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 18-20—Pittsburgh, Pa. *(Hotel William Penn)*
ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA. (15th Annual Water Conference). Sec'y, W. M. Porter, Hotel Wm. Penn, Pittsburgh, Pa.

Oct. 18-22—New York, N. Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N. Y.

Oct. 19-22—Atlantic City, N. J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

Oct. 21—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

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Write for our condensed catalog containing information to help you in selecting the more detailed bulletins which are available covering all the types of water and sewage treatment.

Bulletin 60-E

DO YOU WANT INFORMATION ABOUT THE MOST MODERN FILTER CONTROLLERS & GAUGES?

C.-A.-P. SYSTEM® instruments provide flow control as well as accurate measurement of loss of head and rates of flow.

Bulletin 1100-E

ARE YOU CONSIDERING A CLARIFICATION OR SOFTENING PLANT?

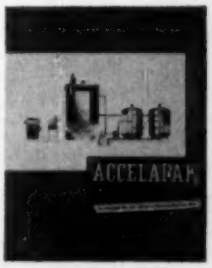
Whether a new plant or enlargement of an old is needed, the ACCELATOR® clarifier or softener will provide the best results at the lowest installed cost. In many cases an "ACCELATOR" mechanism can be installed in an existing basin to increase capacity as much as 400%.

Bulletin 1825-E

DO YOU NEED WATER TREATMENT FOR SMALL COMMUNITIES?

The "ACCELAPAK" treating plant employs the most modern methods of treatment – developed specifically for small municipalities where technically trained operators are not available.

Bulletin 1870-E



It's the results that count!

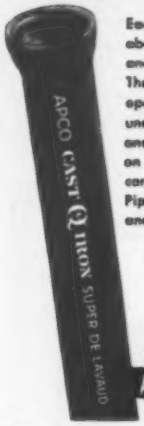
INFILCO equipment and treatment methods have long been recognized leaders in the field because emphasis is on performance with the best combination of equipment for effective, economical operation.

INFILCO

INFILCO INC. *Tucson, Arizona*

Plants in Chicago and Joliet, Illinois

SALES OFFICES IN 33 PRINCIPAL CITIES IN THE U. S., CANADA AND MEXICO



Each length of pipe we manufacture passes through the above hydrostatic test press where it is filled with water and the pressure raised to 500 pounds per square inch. The most common water works pipe is designed for an operating pressure of 150 pounds per square inch. This undergoes the 500 pounds per square inch hydrostatic test and permanent records for each piece of pipe are kept on file for inspection by our customers at all times. You can be assured with Alabama's Super De Lavaud Cast Iron Pipe. In sizes of 3" to 24" in modern long lengths. Bell and Spigot, Mechanical Joint and Flanged Pipe.

General Sales Offices
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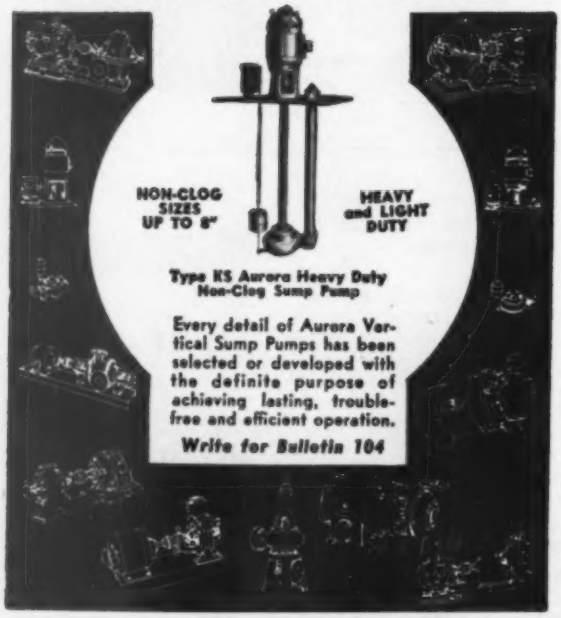
We Invite Inquiries to Our Nearest Sales Office
130 S. Michigan Ave. Chicago, Illinois
250 Fifth Avenue New York 1, New York
ALABAMA PIPE COMPANY
ANNISTON ALABAMA

These are Impressive Performers


NON-CLOG SIZES UP TO 8"
HEAVY and LIGHT DUTY
Type KS Aurora Heavy Duty Non-Clog Sump Pump
Every detail of Aurora Vertical Sump Pumps has been selected or developed with the definite purpose of achieving lasting, trouble-free and efficient operation.
Write for Bulletin 104

DISTRIBUTORS IN PRINCIPAL CITIES
AURORA Always PUMPS
AURORA PUMP COMPANY
68 Loucks St., Aurora, Illinois
DIVISION OF THE NEW YORK AIR BRAKE COMPANY

Oct. 21-23—Eugene, Ore. *(Upper Willamette Valley)*
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Walter W. Saxton, 408 Old Capitol Bldg., Olympia, Wash.

Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.

Oct. 25-27—Montreal, Quebec *(Windsor Hotel)*
CANADIAN INSTITUTE ON SEWAGE & SANITATION. Sec'y, Dr. Alfred E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto, Ont.

Oct. 25-27—St. Louis, Mo. *(Statler Hotel)*
AMERICAN CONCRETE PIPE ASSOCIATION. (Fourth Annual Short Course). Director, Howard F. Peckworth, 228 N. LaSalle St., Chicago 1, Ill.

Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 27-28—Springfield, Ill.
ILLINOIS WATER WORKS OPERATORS CONFERENCE. Sec'y, Clarence W. Klassen, State Dept. of Health, Springfield, Ill.

Oct. 27-29—Baltimore, Md. *(Belvedere Sheraton Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D. C.

Oct. 28—Fairfield, Conn. *(Patterson Club)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanaugh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.

Nov. 4-6—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N. J.

Nov. 8-9—Huntington, W. Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W. Va.

Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-10—Asheville, N. C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N. C.

Nov. 9-10—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.

Nov. 9-10—Huntington, W. Va. *(Prichard Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, G. O. Fortney, State Dept. of Health, Charleston, W. Va.

Nov. 11-12—McCook, Neb. *(Keystone Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 West B Street, McCook, Neb.

Nov. 15-20—Stillwater, Okla. *(Student Union Bldg.)*
OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTE CONFERENCE. (Annual Meeting). Sec'y, H. J. Darcey, State Dept. of Health, Oklahoma City, Okla.

WE PLEAD GUILTY

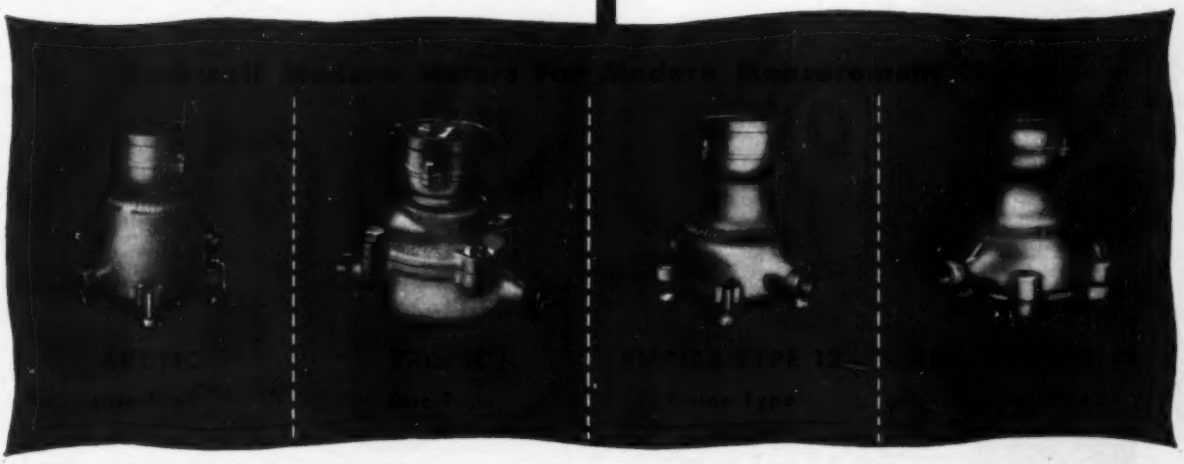
To Improving Water Meter Performance

Chances are the meters you bought 20 or more years ago are costing you money way out of proportion to their revenue earning capacity. These old meters, even when new, could not approach the performance we're building into meters today.

We've worked constantly for improvement and our meters show it. Engineering, research and manufacturing have combined their talents to make Rockwell meters measure at top accuracy for longer periods at lower cost.

So think twice before again repairing a meter that creaks with age. Think first of the costs in parts and labor and weigh them against the cost of a new Rockwell. Then think of the greater revenue a new Rockwell will earn for you.

Let the Rockwell representative furnish proof that a planned program of meter replacement will so materially benefit your overall operations that it will more than pay for itself.



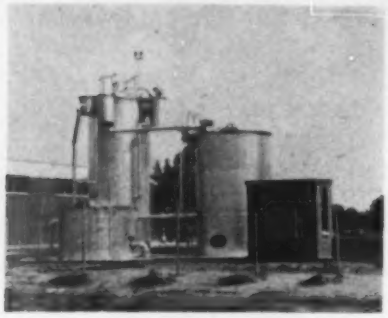
The Symbol for Service, Quality and Performance in Water Meters

ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Chicago Houston
Los Angeles N. Kansas City New York Philadelphia
Pittsburgh San Francisco Seattle Tulsa

In Canada: Peacock Brothers Limited

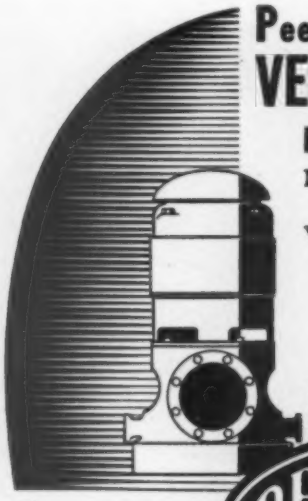
AN ALL STEEL
Waste Treatment Plant



The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

The new Spiragester Bulletin, No. 135, will be available the last part of October, 1954.

LAKESIDE ENGINEERING CORPORATION
222 West Adams Street • Chicago 6, Ill.



Peerless VERTICAL PUMPS

Deep Well and Close Coupled Pumps for Water Supply, Cooling Tower Service, Flood Control, Drainage, Sewage Disposal and Process Services.

Write for descriptive Bulletin on type you require.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corp.
Factories: Los Angeles, Cal.; Indianapolis, Ind.
Offices: New York; Chicago; St. Louis; Atlanta; Phoenix; Dallas, Plainview and Lubbock, Tex.; Fresno; Los Angeles; Albuquerque.

PEERLESS PUMPS
PEERLESS BUILDS DEPENDABLE PUMPS

Nov. 17-19—Allerton Park, Ill. *(Univ. of Illinois)*
ILLINOIS WATER WORKS MANAGEMENT SHORT COURSE. Director, Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Nov. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Nov. 28-Dec. 3—New York, N. Y. *(Statler Hotel)*
AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Annual Meeting). Sec'y, C. E. Davies, 29 West 33rd St., New York, N. Y.

Dec. 2-4—Havana, Cuba *(Sociedad Cuban de Ingenieros)*
CUBAN SECTION A.W.W.A. Sec'y, Laurence H. Daniel, Baratillo 9, Havana, Cuba.

Dec. 8—Winthrop, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Dec. 16—Boston Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Jan. 18, 1955—New York, N. Y. *(Sheraton Hotel)* Grand Ballroom
NEW YORK SECTION A.W.W.A. (Mid-Winter Luncheon Meeting). Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Jan. 20—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Jan. 20-21—New York, N. Y. *(Hotel Belmont Plaza)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.

Feb. 9-11—Indianapolis, Ind. *(Lincoln Hotel)*
INDIANA SECTION A.W.W.A. Sec'y, R. J. Becker, 1330 W. Michigan Street, Indianapolis, Ind.

Feb. 17—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Mar. 21-23—Savannah, Ga. *(DeSoto Hotel)*
SOUTHEASTERN SECTION A.W.W.A. Sec'y, N. M. de Jarnette, 245 State Office Bldg., Atlanta, Ga.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, H. W. Badley, 119 West Cloud, Salina, Kans.

Apr. 20-22—Buffalo, N. Y. *(Statler Hotel)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Apr. 29-30—Butte, Mont. *(Finlen Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Dept. of Health, Helena, Mont.

June 12-17—Chicago, Ill.
AMERICAN WATER WORKS ASSOCIATION. (75th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N. Y. (Reservations announcement by Nov. 1st.)

Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

Fluoride-treated water will not injure batteries provided the water could be used before it was treated.

* * *

A light coating of iron sulfide in a low pressure sediment strainer ignited at the Little Miami sewage works in Cincinnati, Ohio.

* * *

Some time before his death, Will Rogers came up with a solution to the congested traffic situation. His formula is even more fitting today. There should be a law, he proposed, that the streets can be used only by autos that are paid for.

* * *

Last summer 1,072 public water supply systems, serving 24 million people in 45 states, were forced to restrict the use of water by part or all of their customers.

* * *

Investigations have shown that where water for irrigation is withdrawn above a municipal intake only 20-60 per cent returns to the stream.

* * *

The activity of methane-producing bacteria can be increased by passing CO_2 through sludge digestion tanks, according to Hawkes and Jenkins.

* * *

At Allentown, Pa., with a Palmer Agitator to provide surface wash of rapid sand filters, mud balls were practically eliminated in five weeks operation of a full scale unit.

* * *

$7,000,000 Sewage Disposal Project for Skokie Valley

The North Shore Sanitary District of Illinois is planning a $7,000,000 project for improving and increasing sewage disposal facilities in the Skokie Valley north of Chicago. Included is a treatment plant scheduled for completion in 1957. The purpose is to clean up pollution in the Skokie River and Skokie Lagoons, expected to be complete by 1959 according to John S. White, president of the North Shore Sanitary District board of trustees.

CLARK SERVICE BOXES
Neat – Safe – Permanent

This cast-iron plug screws into brass insert... cannot be twisted or broken off.
Sliding adjustment prevents frost from disturbing base and curb cock.
Steel extension rod with welded joints—available with all types of boxes.
STYLE A—Clark Service Box for use with iron pipe.
STYLE B—for use with lead (illustrated) or copper pipe.
STYLE M—for use with Minneapolis Type Curb Stops.

write

H. W. CLARK CO.
MATTOON, ILLINOIS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Corrosion and Rust Resistant Winch-Hoist

1001

The Lug-All Co., Wynnewood, Pa., has developed a husky, little (8¾ lb.) Lug-All Winch-Hoist for use under conditions where rust and corrosion normally shorten the life of hoists and other metal tools.

Lug-All's new "Marine" has a 133 strand stainless steel, pre-formed aircraft cable. The frame is aluminum alloy. All aluminum parts are anodized.

The "Marine" weighs only 8¾ lbs., yet lifts, lowers or pulls 1½ ton. When used with single cable, it lifts, lowers or pulls ¾ ton.

Tampers

1002

Worthington Corporation, Harrison, N.J., has announced a newly designed Backfill Tamper, known as W-18, and a new Triplex Tamper, known as WT-18.

The features emphasized are smooth exteriors free from nuts, bolts or other projections likely to interfere with the operator; new, positive acting disc valve providing consistent action; positive lock on the gland nut keeps the front end tight and the packing adjusted as set; built-in lubricator with large capacity oil supply. The company also claims lower air consumption and low maintenance costs for the new tampers.

Liquid Level Control

1003

Photoswitch Incorporated, New York, N.Y., has announced the introduction of Level Control Type 13DJ3. Incorporating the latest techniques of electronic design, Level Control Type 13DJ3 controls the level of all electrically conductive liquids.

The control consists of an electron tube amplifier and relay combination which operates from minute currents in the probe circuit. Except for annual replacement of a long-life electron tube, it is completely maintenance-free as there are no floats or stuffing boxes to wear or fail in operation. Contact with the liquid is made only by corrosion-resistant stainless steel probe rods. Accuracy is independent of temperature and pressure. A single control, through flexible terminal panel connections, provides for operation as either a pump-up or pump-down control, or a high or low level safeguard with fail-safe action for all five types of operation. The control is universal for either 115 or 230 volts 50/60 cycle supply.

New Bearing Compound

1004

Chemical & Power Products, Inc., New York, N.Y., has developed a new hard, corrosion-resistant, low friction coefficient compound, called Style FM-4. This special compound of Teflon, glass, graphite and an inert lubricant is highly suitable for use as bearing, bushing and similar products in operations where material is exposed to corrosive action.

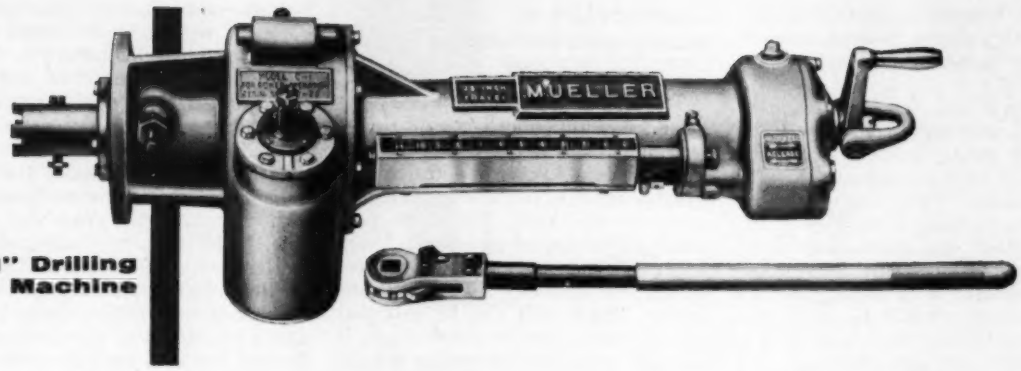
It is being used satisfactorily as a bearing on submerged pumps where other bearing materials have failed. Style FM-4 is also being used as a

THIS IS NO "BULL!"
"Flexibles" really solve sewer-cleaning problems!

Mexico City has a unique and serious sewer problem. Due to the settling of a large portion of the city, it is now approximately 20 feet lower than its sewer outlet, the Grand Canal. Until the condition is corrected and normal flow restored, there is a continuing problem of removing solids from the sewers, some of which are more than 300 years old. As a solution, the city has purchased over 200 "Flexible" Bucket Machines—one of which is pictured. Mexico City endorses "Flexibles" for their efficient performance and ease of operation and maintenance. We invite the opportunity to give your city an "on the job demonstration."

Write for our FREE Catalog
Flexible SALES CORPORATION
3786 Durango Ave., Los Angeles 34,
(DISTRIBUTORS IN PRINCIPAL CITIES)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT



"C-1" Drilling Machine

MUELLER

Proven Design Gives Versatility

Install needed valves and connect branch mains, under pressure, with a Mueller "CC" or "C-1" Drilling Machine!

Versatility has been carefully designed into the "CC" and "C-1", permitting their use with Mueller Inserting Valves, Tapping Sleeves and Valves, Gate Valves and special fittings to perform a wide variety of water works operations.

Both machines are similar in design and construction except that the "CC" is hand operated and the "C-1" is power operated by an air motor or portable gasoline engine drive unit. They constitute part of a complete line of drilling and tapping machines designed to meet your every need.

Consult your Mueller Representative or write direct for complete information.

"CC" Drilling Machine

SPECIFICATIONS

Makes cuts 2″ through 12″
500 psi maximum working pressure at 100°F.
500°F. maximum temperature rating at 250 psi
25″ boring bar travel
Automatic or manual feed
Feed indicator standard equipment

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

tail shaft bearing on vertical mixers and reactors where an inert material is needed to be compatible with the product.

Bushings and bearings made of FM-4 can withstand continuous contact with strong acids and organic solvents at both normal and elevated temperatures. They can be easily machined to close tolerances. Used in low speed operations, they often eliminate the need for lubrication, as is necessary with metal bearings and bushings. FM-4 bearings and bushings compare very favorably in wearability with metal bearings and bushings.

Complete Line of Metagraphic Instruments

1005

The Bristol Company, Waterbury, Conn., has announced a new three-part pneumatically-operated instrument system known as the Metagraphic System. In these instruments each of the basic functions performed is packaged separately. Units are: a transmitter, a receiver (recorder or indicator), and a controller. Each unit can be installed on the process at the point where it operates best, thus providing a high degree of flexibility of application.

Metagraphic instruments measure, indicate, record, and control pressure, vacuum, temperature, liquid level, differential pressure, and flow.

A universal 3-15 psi air pressure signal interconnects the three units no matter what variable is being transmitted. This makes the components universally interchangeable. (3 to 18 psi signal span also available.) The new receivers and controllers are designed for full plug-in service. Strip-chart recorders, and indicators are quickly interchangeable without loss of signal or control. Design features include continuous valve position indication requiring no switching to get reading, "bumpless" manual-automatic transfer by simply matching pointers, and a set-point regulator of high-output capacity.

The World's Finest Pipe Cutters

with Pneumatic or Electric Drive

Fein Pneumatic Pipe Saw

for Cast Iron and Steel Pipe up to 60" dia.

"WORTH ITS WEIGHT IN GOLD"

says acting Water Works Engineer for city of 80 thousand population

Fein **PORTABLE AUTOMATIC cuts 8"-60" dia.**

Weight: only 145 lbs. Clearance: 12" max. around pipe. Set up time: 5-10 min. by 1 or 2 unskilled men. Pneumatic and electric machines operate under water. Cuts 8" pipe in 5 min.—24" in 30 min.

Fein **RECIPROCATING HAND SAW: cuts ½"-6" dia.**

Weight: 16 lbs. Cuts profiles and angles up to 45. Will attach to pipe vise. Cuts 2½" pipe in 1½ min.

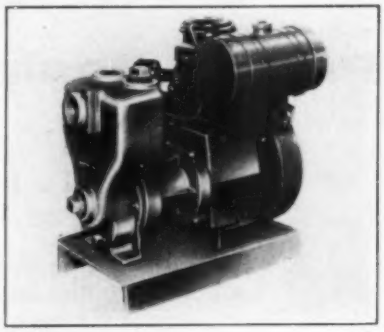
Fein Electric Hand Saw

AMAZINGLY LOW COST. ONE YEAR GUARANTEE

H. R. PRESCOTT & SONS, INC.

QUALITY WATER WORKS SUPPLIES SINCE 1914

BOX 7 — GREENDALE BRANCH — WORCESTER 6, MASS.
TELEPHONE WEST BOYLSTON 5-4431



Self-Priming Pumps

1006

The Universal Manufacturing Co., Berkeley, California, has announced the development of a new improved line of lightweight, heavy duty, self-priming centrifugal pumps. According to the manufacturer, the Universal design incorporates the following features: A new balanced priming port, preventing loss of volume from re-circulation of water; non-clogging semi-open impellers with adjustable clearance to compensate for wear; and a new convertible wear plate to prevent wear on the impeller case. Easy priming is possible, without extra fittings or disturbance of piping, through separate opening in top of the pump case. These new pumps are rated for continuous duty as well as for intermittent service; and exceed the A.G.C. standards in every respect.

Complete Line of Emulsion Cleaners

1007

Turco Products, Inc., Los Angeles, California, has developed a complete line of seven emulsion cleaners.

Turco emulsion cleaners, according to the manufacturer, offer a very simple spray-on method of removing grease and oil from metals and machinery. Added in small amounts to petroleum solvents, Turco emulsion cleaners act with these solvents like soap acts with water . . . they increase the penetrating power of the solvents . . . speed the cleaning action . . . improve the rinsing properties.

And yet, emulsion cleaners are probably the least expensive type of cleaning material available to industry today . . . inexpensive to put to use (since they are used at such high dilutions) and inexpensive to keep in use. Turco emulsion cleaners are said to require no expensive equipment . . . no highly trained operating personnel.

Boring and Tunneling Machine

1008

Multi-Matic Corp., Van Nuys, Calif., has developed a new model Super Hole-A-Matic, one-man operated earth boring and tunneling machine that will dig holes up to 12 inches in diameter, 15 feet deep. A complete machine, the Super Hole-A-Matic is lightweight, portable, and costs far less than similar equipment for boring or tunneling.

Operating in any remote location from a 1.5 KW (or more) AC or DC generator, the Super Hole-A-Matic will not bend, break or throw the operator. It works with a pulverizing, grinding action unlike the auger-type machines which screw into the earth and require great manual effort to break loose. Super Hole-A-Matic chews up soft shale and rides above large rocks without damage, boring holes at any angle and tunneling with equal ease and efficiency.

FOR ACCURATE REMOTE MEASUREMENT

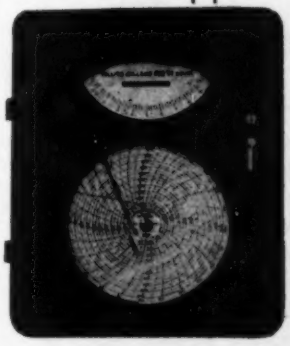
of Flow, Liquid Level, Pressure

NEW! SIMPLEX ORTHOFLOW®

• Now you can transmit data accurately over great distances for instant reference at central or control points.

TRANSMITTER – Compact new electric unit actuates both in-plant and remote meters . . . unaffected by normal variations in voltage, temperature. Simple, dependable, rugged. Accuracy of ±2% at any point over wide flow ranges.

RECEIVER – Time-proven Simplex H Meter. Precisely duplicates transmitted data . . . automatically resets to correct data after power interruptions. Indicates, records, totalizes. Easy-to-read flow scale and chart.



SIMPLEX VALVE & METER COMPANY
6743 Upland St., Philadelphia 42, Pa.

Write for Brochure

SIMPLEX®
VALVE AND METER COMPANY

Simple Field Test For Water Hardness

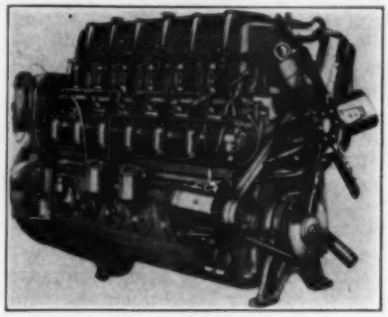
1009

Calgon, Inc., and Hagan Corporation, Pittsburgh, Pa., have announced that field tests of water hardness sensitive to one grain per gallon (17.1 parts per million) require only a minute with their "Speedy-Kit."

A sample of water is measured into a marked glass vial; two drops of "Solution A" are added from a bottle, turning the water red. "Solution B" from a second bottle then is added, one drop at a time, until the red color changes to blue. Each drop of "B" used represents one grain per gallon of hardness, as calcium carbonate.

The method employed in using the new kit and contents—two bottles with "eyedropper" tops, one glass vial—represents a simplification of water test procedures based on Schwarzenbach methods.

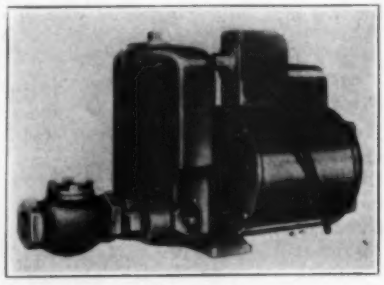
The Speedy-Kit is of pocket size —4⅝" long, 3" wide, 1⅛" deep and weighs only 6 ounces. The box is made of sturdy, clear plastic. A water-resistant instruction card is secured in the lid. Contents include glass vial, glass bottle of solution "A" and plastic bottle of solution "B."



New, Improved Diesels

1010

P&H Diesel Engine Division, Crystal Lake, Ill., has announced that Harnischfeger Corporation is now in production with a complete improved line of 2-cycle diesel engines featuring 36% greater power output. While of the same basic design as the former models, the new higher performance engines carry 52 major advancements and refinements. The new diesel engines feature even greater simplicity of design and construction, and are rated by the manufacturer as the most powerful for their size and weight built today. Operating speed has been increased to 1800 r.p.m. Compression ratio of all models is 16 to 1 and bore and stroke are 4.5"x5.5".



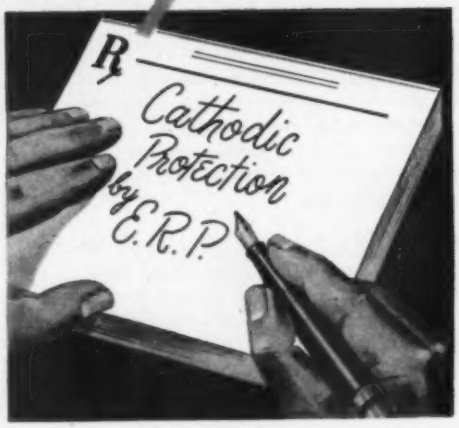
Double Duty Pumps

1011

Jacuzzi Bros. Inc., Richmond, Calif., has announced a new line of Jacuzzi pumps and water systems to be called "Series RP—Double Duty Pumps." New engineering developments are added to make this water system line 100% automatic in operation.

These new Jacuzzi Series RP units are self-priming shallow well jet pumps, and are also available for installation in deep wells, hence the term "double duty." Increased ef-

℞ FOR CORROSION...



You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required to achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.

Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been completely protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years*, these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

COMPLETE CATHODIC PROTECTION SERVICE • DESIGN ENGINEERING MAINTENANCE INSTALLATION EQUIPMENT

ELECTRO RUST-PROOFING CORP. (N. J.)
BELLEVILLE 9, NEW JERSEY
REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

E-27

ficiency is responsible for the greater pumping capacity obtainable—up to 500 gallons per hour for a ⅓ horsepower pump.

According to Jacuzzi, the Series RP pumps feature a new design called "Synco-Flow" which eliminates entirely any control valve on the pump. Control valves on deep well pumps frequently are the source of trouble and the new "Syncro-Flow" design is said to increase the over-all efficiency of the pump while making a control valve completely unnecessary.

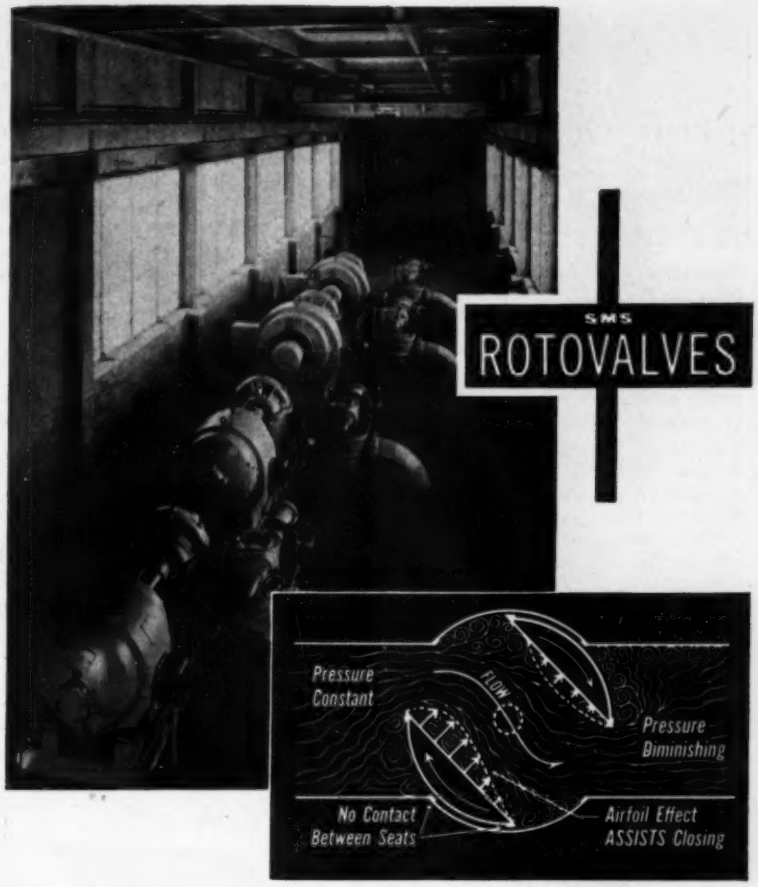
Each of the Jacuzzi Series RP water systems is equipped with Jacuzzi's patented "Jet Charger" which automatically prevents the pressure tank from becoming water logged. Tank draining to admit air into the tank is unnecessary.

Automatic Knife Pipe Cutters

1012

Beaver Pipe Tools, Inc., Warren, Ohio, has developed a new Automatic Knife Pipe Cutter for hand or power use.

Different types of knives are available for cutting, beveling for weldments or grooving for compression type joints, and for cutting Saran lined pipe. They can be quickly changed for the various operations. These new Beaver knives have the famous Beaver "Safety-Depth Guide" ahead of the cutting edge to prevent "hogging in" and knife breakage. Made for use with the Beaver Nos. 5, 10, 104, 106, 108 and 112 Geared Cutters, ⅛ to 12 inch, plus the Beaver A, B and E Pipe Machines, ½ to 2 inch, these new Beaver knives cut pipe without leaving burrs, and also make weldments and victaulic joints.



Hydraulic Imbalance Makes SMS-Rotovalves

EASY TO OPERATE

SMS-Rotovalves are easier to open and close. As shown in the diagram, hydraulic imbalance effects an airfoil on the valve's inner surface to assist closing. The conical plug first lifts, then turns on bronze trunnions to eliminate friction and wear on seats, finally reseats. This eliminates the causes of failure and breakage.

Because SMS-Rotovalves need less effort to operate, one man can handle manual opening or closing. In electric operation, smaller motors can be used without increasing operating time. Hydraulic or pneumatic operation requires smaller cylinders and less pressure.

These exceptional performance characteristics are the results of over 75 years of hydraulic research and engineering. For detailed information on our complete line of Rotovalves, Ball and Butterfly valves, see our local representative, or write to the S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
Pumps
Gates & Hoists
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Accessories
HYDRODYNAMICS
Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

SMS
S. MORGAN SMITH CO.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Gooseneck Boom for Pitman Crane

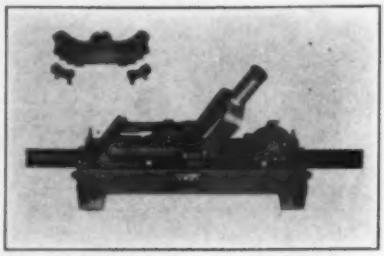
1013

Pitman Mfg. Co., Kansas City, Mo., has developed something entirely new and different in the truck-crane field, a hydraulically operated goosenecking boom. The new boom is now available as an optional accessory on the Pitman Crane, Model 80, 4-ton truck crane.

This unique boom, believed to be the first of its type ever offered commercially, was developed by Pitman as a quick, easy solution to overhead travel clearance problems.

The Pitman Crane is designed so that a trailer can be pulled by the same truck on which the crane is mounted. The crane can be used to load directly onto and off of this trailer.

With the new gooseneck-type boom, the operator can fold the boom down over a loaded trailer simply by pushing a lever at his regular operating station and be ready for road travel in a matter of seconds. Pitman officials assert that the Model 80 with its gooseneck boom will enable contractors, utility companies and others to reduce drastically equipment and manpower costs of handling and hauling pipe, poles, steel and many other types of materials.



New Gripper Dog for Pipe Puller & Pusher

1014

The Trojan Manufacturing Co., Troy, Ohio, has developed a new gripping dog, for use on their Model B Pipe Puller and Pusher, that increases the life of the dog 4 times and cuts maintenance costs correspondingly. Individual inserts, made of high quality steel and carbonized for long life, are used for each step on the dog. All inserts are interchangeable with one another—and as they wear, can be replaced by inexpensive new inserts—thus eliminating the necessity of buying a complete new dog.

The Model B, which is designed to install or renew pipe under pavement without breaking the surface, will push or pull pipe up to 2" in diameter without additional dogs, clamps or wedges. In operation, it requires only a 5½' trench . . . saves time and money by eliminating all time-killing resetting of the grip . . . has 3 pushing speeds for different types of soil . . . and can be reversed in 30 seconds by simply turning the dogs over in the opposite direction. It is constructed entirely of steel—with the sturdy frame welded into one integral member—and all individual parts made heavy enough to withstand the most severe treatment. Total machine weight is only 140 lbs.

NEW... MOBILE... HIGH CAPACITY...

ROYER SLUDGE DISINTEGRATOR

Designed for tractor bucket feeding the latest model in the line of Royer Sludge Disintegrators, the NSYP-EG, is capable of handling up to 150 cubic yards of sewage sludge per hour. This highly mobile "over-the-road" unit is mounted on a four-wheeled chassis with 6.00x16 tires, tow-bar and automotive steering. Power is supplied by a 36 HP air cooled Wisconsin gasoline engine.

This unit's 60" wide receiving hopper and 3' wide combing belt can receive and process the contents of a 12 cubic foot bucket as fast as the loader can deliver. Ideally suited for use where large quantities of sludge are being processed into saleable fertilizer . . . entirely eliminating costly manual operations.

Send for descriptive bulletin giving complete data on the many units in the Royer line of sewage sludge disintegrators.

ROYER foundry & machine co.

170 PRINGLE ST., KINGSTON, PA.

ROYER

Food Machinery and Chemical Corp. Acquires Chicago Pump Company

Food Machinery and Chemical Corporation, San Jose, California, has announced its purchase of Chicago Pump Company.

Ben C. Carter, FMC executive vice president, stated that Chicago Pump Company was acquired to complement FMC'c regular lines of Peerless industrial and agricultural pumps with a line of specialized equipment in the waste disposal and building fields.

Chicago Pump Company, a pioneer of electric driven centrifugal pumps, was organized at Chicago, Illinois, in 1909. Today the company's major product lines are: sewage treatment and disposal equipment, water treatment equipment, and service pumps for commercial and industrial buildings.

As a subsidiary of FMC, Chicago Pump Company will be an operational component of the parent corporation's Peerless Pump Division. According to G. F. Twist, FMC vice president and manager of Peerless, the newly acquired subsidiary will continue to operate under the direct management of George D. Bers, president of Chicago Pump, and Milton Spiegel, vice president and general manager.

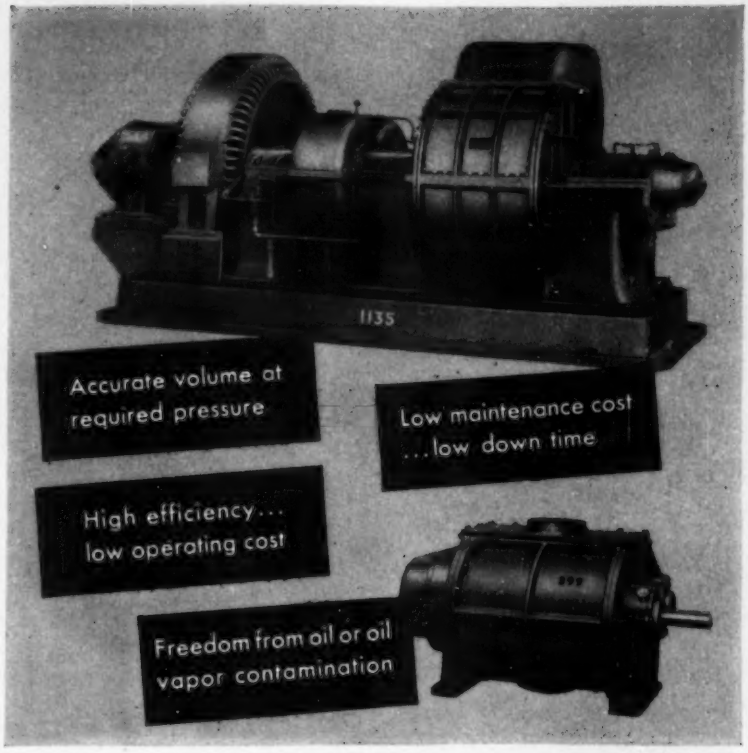
Erikson Retires, Hopwood Elected President of Hagan Corp.

Hagan Corp., Pittsburgh, Pa., has announced that David J. Erikson, who rose in nearly four decades of service from draftsman to president of Hagan Corporation and subsidiary companies, announced his retirement at a recent meeting of the board of directors.

Although retiring because of ill health, Mr. Erikson acceded to the board's request that he serve as a consultant. He plans to move the family residence to California at a later date.

Elected to succeed him was W. W. Hopwood, son of the founder of this combustion and chemical engineering and manufacturing firm.

Mr. Hopwood, the newly elected president, at 39 is one of the youngest men to head a major industrial firm. A native Pittsburgher, like his predecessor, he worked for his father's company during vacations from Dormont High School, where he was graduated in 1933. He continued his summer work for the firm while in college and, in 1938, after his graduation at New York University with the B.S. degree in Accounts and Finance,


1135
Accurate volume at required pressure
Low maintenance cost ...low down time
High efficiency... low operating cost
Freedom from oil or oil vapor contamination

LOOK FOR THE "BIG 4"

WHEN YOU BUY BLOWERS

Successful over-all performance of blowers calls for continuous, long-time ability to meet these basic requirements. In any specific case, one may be more important than another. But, when you select Roots-Connersville equipment, you sacrifice none of these four essentials. That is true, whether your requirements are for a whisper of air or for a tornado. You'll find the R-C range of capacities so extensive that you can very closely match your needs, with resulting economies in both first cost and operating cost. Further, you have the choice of either Rotary Positive or Centrifugal Blowers, from the exclusive R-C *dual-ability* line.

The ability to deliver blowers with these fundamental values comes from our century of specializing in problems of handling gas and air. The proof of this ability is readily found in our list of long-time customers who have gained complete satisfaction by entrusting their blower problems to Roots-Connersville. Ask us about your present or future needs in equipment to handle gas or air.

ROOTS-CONNERSVILLE BLOWER

Reg. U.S. Pat. Off.

A DIVISION OF DRESSER INDUSTRIES, INC.
1354 Mount Ave. • Connersville, Indiana

BLOWER BUILDERS SINCE 1854

Specialists in handling gas and air

It's ...a Versatile **COAGULANT!**

No matter what the season, whether Spring flood or Summer drought, there is always a turbidity problem to some degree. And an effective coagulant for any water treatment problem is TC FERRI-FLOC, a partially hydrated ferric sulphate. A stable, free flowing granular salt, FERRI-FLOC may be fed with few modifications through any standard dry feed equipment. Only mildly hygroscopic, it permits ease of handling and closed hopper storage over long periods of time.

Water Treatment

Ferri-Floc coagulates surface or well waters, and it aids taste and odor control. It is effective in lime soda-ash softening, and is adaptable to treatment of practically all industrial water or wastes.

Sewage Treatment

Ferri-Floc coagulates waters and wastes over wide pH ranges. It provides efficient operation regardless of rapid variations of raw sewage, and is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

ferri-floc **HAS THESE SUPERIOR ADVANTAGES!**

1 *Rapid Floc Formation* 2 *PH correction* 3 *Taste and odor control* 4 *Color removal* 5 *Softening* 6 *Ease of operation* 7 *Bacterial removal* 8 *Manganese and Silical removal* 9 *Turbidity removal* 10 *Economy*

SULPHUR-DIOXIDE HIGHEST QUALITY SO_2

SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER TC SULPHATE

COPPER SULPHATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Samples, Specifications and Detailed Information Available upon Request.

TENNESSEE TC CORPORATION

617-629 Grant Building, Atlanta, Ga.

became a full-time employee of Hagan Corporation.

During five years' service in the Air Corps during World War II, Bill Hopwood earned a commission, became a bomber pilot in B-17's and B-29's.

In 1949, at the age of 34, but with more than a decade of experience with Hagan Corporation and its subsidiaries—Calgon, Inc., Hall Laboratories, Inc., the Buromin Company—he was elected vice president and director.

American Wheelabrator Makes Personnel Advancements, Additions

American Wheelabrator & Equipment Corp., Mishawaka, Indiana, has announced promotions in and additions to its field sales and service personnel.

In the company's Detroit office, William A. Illsley was promoted to District Sales Engineer. He formerly served as Sales Engineer in the company's home office. In Springfield, Massachusetts office, W. J. Sutherland was promoted to the post of District Sales Engineer. He formerly was Service Engineer in that office. John H. Burlingame has been appointed to that office as Service Engineer.

In the company's Cleveland office, C. J. Osborn was promoted to District Sales Engineer, having formerly been District Service Engineer in that office. Dean T. Pournaras was appointed to that office as the new District Service Engineer.

John J. Savignac has been appointed to the firm's Milwaukee office as a District Service Engineer.

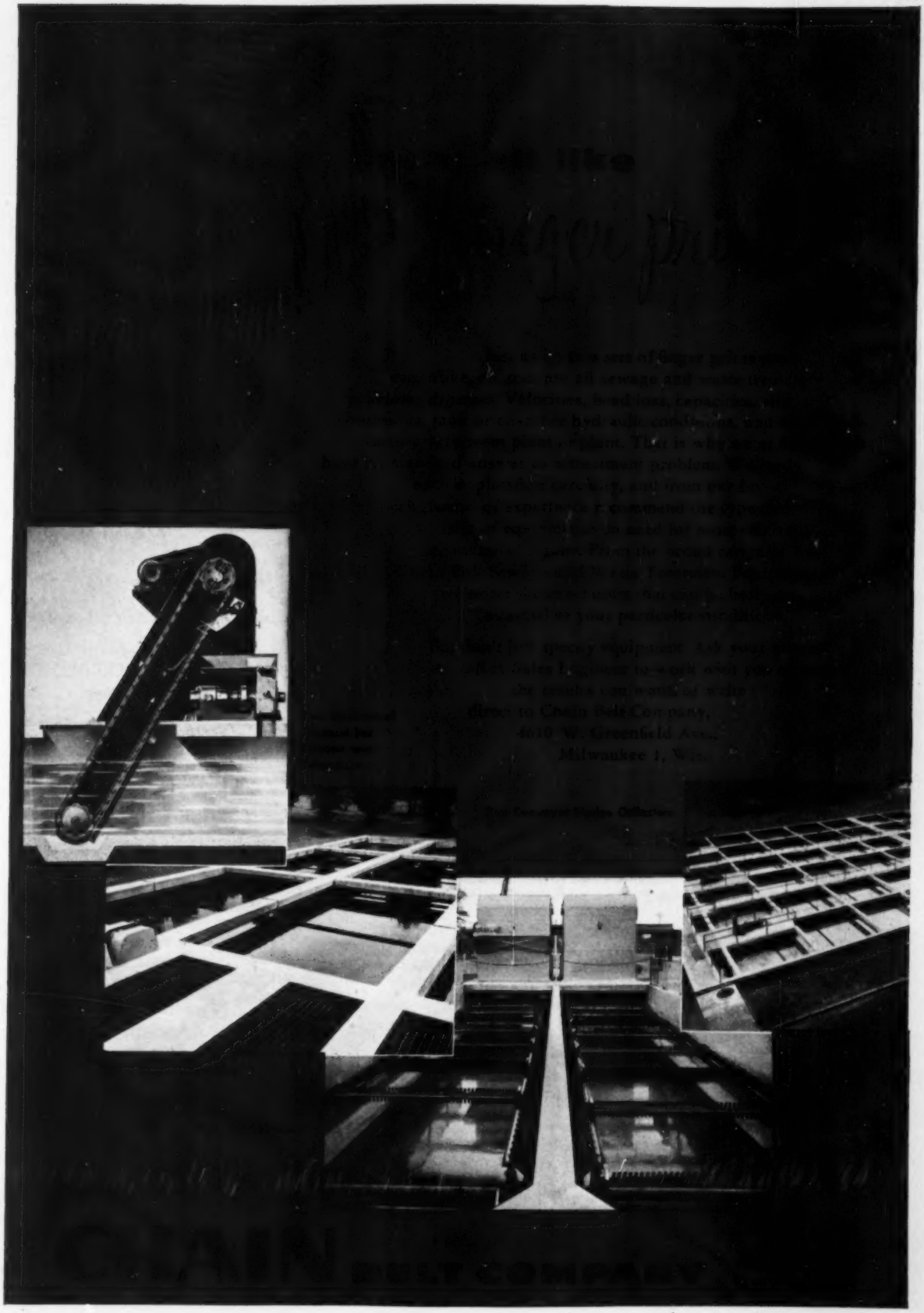
In the Indiana office, at Mishawaka, Indiana, Robert E. Gallatin was appointed District Sales Engineer. Harold Groh was made District Service Engineer to succeed District Service Engineer Bruce Berger, who has been promoted to the home office engineering department.

Neptune Appoints Malley In New England

Neptune Meter Co., New York, N. Y., has announced that Albert J. Malley, Jr., has been named a sales representative for the Company in New England.

Mr. Malley will handle Neptune's water, petroleum and special industrial meters in the six-state area under the direction of Mr. McGarry, branch manager of the firm's Boston office.

Formerly in the sales department of Aircomo Corporation of Newark, N. J., Mr. Malley had previously been



associated with the textile industry in Media, Pa., and Passaic, N. J.

A native of Haverhill, Mass., he attended Fair Lawn High School in Fair Lawn, N. J., and the Lawrence Academy in Groton, Mass. After graduating from Gettysburg College, Gettysburg, Pa., where he majored in economics and business administration, Mr. Malley served in the U. S. Marine Corps from 1951 to 1953.

O'Connell Appointed Sales Engineer by Permutit

The Permutit Company, New York, N. Y., has announced the appointment of Mr. Robert Fay O'Connell as Sales Engineer of its St. Louis, Mo., office.

Mr. O'Connell started with the company in November, 1953, and prepared for his new position as a sales trainee at the New York offices.

Prior to joining Permutit, he spent seven years with the Phelan Faust Paint Mfg. Co., St. Louis, Mo., as plant engineer and development chemist and two years with the Firestone Tire & Rubber Co., Akron, Ohio, as chief analytical chemist. Sandwiched between these positions, he served three years in the service of the United States Navy in the Submarine Corps.

He attended Washington University, St. Louis, Mo., receiving a Bachelor's degree in Chemical Engineering in 1941, and is a member of the U. S. Naval Reserve and the American Chemical Society.

Far Better Today Than Ever Before Modern Permanent

CAST IRON PIPE

Two centuries of use abroad and over 100 years of continuous operation in more than 50 American cities are only a part of the proud service record of cast iron pipe in water mains.

Rugged and durable as was the crude pipe made in those distant days, it does not compare in quality, efficiency and versatility with the modern cast iron pipe produced today by our nation's progressive pipe plants.

During the 72 years that our Company has manufactured quality pig iron from which quality pipe is made, we have observed with enthusiastic interest the many notable advances in cast iron pipe production.

Thanks to research, better pig iron, close controls of iron analysis, new and improved processes, modern cast iron pipe is definitely *stronger, tougher, more uniform and more economical than ever before.*

Our Company salutes the Cast Iron Pipe manufacturers of America for their important contribution to the good health of our country's growing communities at the lowest cost to taxpayers.

WOODWARD IRON COMPANY

WOODWARD, ALABAMA

Byron Jackson Manufacturing Deepwell Pumps in Mexico

Byron Jackson Co., Los Angeles, has announced that its wholly-owned subsidiary, Byron Jackson Co., S.A., a Mexican corporation, is now manufacturing deepwell turbine pumps in its recently acquired plant in the new manufacturing district outside Mexico City.

Mr. E. S. Dulin, President of Byron Jackson Co., states that the Company now can supply the growing needs of Mexican agricultural, industrial and domestic development and that the new plant facilities evidence the confidence of himself and the directors of the parent company in the great future of Mexico's economy.

Outside of supervisory personnel and engineers, the company employs only Mexican labor and obtains all available manufacturing material and supplies in Mexico.

Bailey's Los Angeles Office Moves to Larger Quarters

Bailey Meter Company, Cleveland, Ohio, has announced that the Los Angeles District Office of the company has moved to larger quarters. The new address is 816 South Atlantic Blvd., Monterey Park, Calif.

Under the managership of L. F. Richardson, the Los Angeles District is staffed by Instrument Engineers who are specialists in combustion and automatic controls for power and process applications.

The Los Angeles District territory includes southern California, the southern tip of Nevada, the state of Arizona, and Hawaii.

U. S. Pipe Appoints New England Agent

United States Pipe and Foundry Company, Birmingham, Alabama, has announced the appointment of John C. Finn as New England Sales Agent.

Mr. Finn succeeds R. E. Sweeney, who terminated his employment with U. S. Pipe on July 1. Mr. Finn is a graduate civil engineer from Northeastern University. He has been associated with the Boston Office since 1937 and is well known in the water, gas and sewerage fields in New England.

W. E. Borbonus

Centriline Elects W. E. Borbonus President, K. K. Kirwan Vice President

Centriline Corp., New York, N. Y., subsidiary of Raymond Concrete Pile Co., has announced that William E. Borbonus has been elected President and Kenneth K. Kirwan Vice President and Chief Engineer of the Corporation.

Mr. Borbonus succeeds James P. Cummins, who has been President of Centriline Corporation since 1951. Mr. Cummins has been assigned to the Sales Department of Raymond Concrete Pile Company. He will also continue his official interest in Centriline as a director.

A native of Philadelphia, Mr. Borbonus attended Temple University and the University of Pennsylvania. In 1927 he became associated with R-S Products Corporation in Philadelphia, one of the pioneer manufacturers of industrial heat-treating furnaces and butterfly valves. In 1939 he was elected President and Chairman of the Board of that organization, a position he held until 1951.

Mr. Kirwan has been connected with the Raymond organization, in a variety of capacities, since 1931. He joined the Centriline Corporation in 1947. Born in Baltimore, Md., he is a graduate of Cornell University. During World War II, Mr. Kirwan served in the E.T.O. as Lt. Col. in the Corps of Engineers.

Yahrmarkt Assigned to Foxboro's Tulsa Office

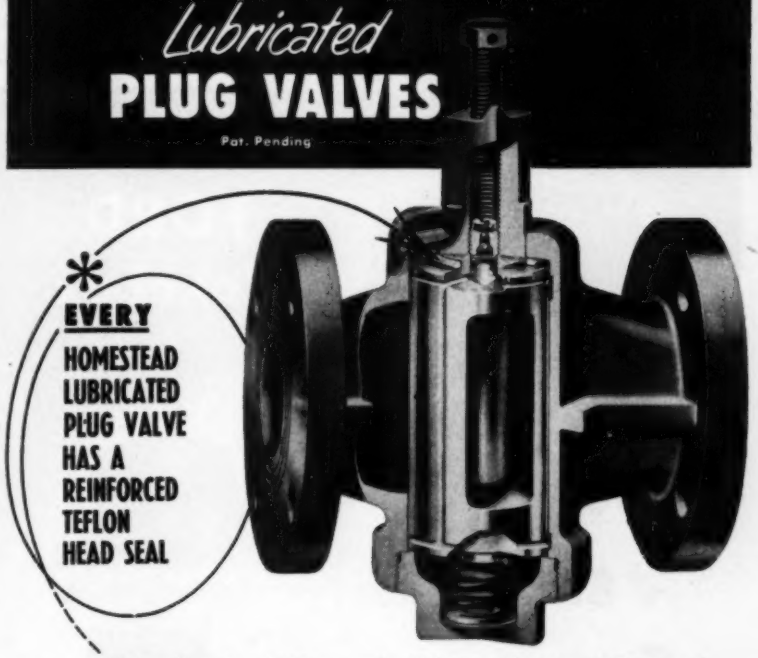
The Foxboro Company, Foxboro, Mass., has announced that Mr. R. S. Yahrmarkt, formerly with the Ethyl Corporation of Baton Rouge, La., has been assigned to Foxboro's Tulsa office as an industrial engineer and will serve instrument users in the Oklahoma area, working under the direction of Mr. J. E. Hewson, branch manager.

Mr. Yahrmarkt's experience in the field of process control includes three years of service with the Ethyl Cor-

No. 1* of . . .

12 REASONS WHY
YOU SHOULD BUY AND USE
LOW-PRICED

HOMESTEAD
Lubricated
PLUG VALVES
Pat. Pending



* **EVERY HOMESTEAD LUBRICATED PLUG VALVE HAS A REINFORCED TEFLON HEAD SEAL**

. . . which will not cold-flow, and which provides a positive seal against leakage—even under 200 pounds pressure per square inch, *without lubrication*.

This is only **ONE REASON WHY** you should buy and use, *low priced* **HOMESTEAD LUBRICATED PLUG VALVES.**

HERE ARE ALL TWELVE

1. Reinforced Teflon head seal.
2. Completely controlled high-pressure lubricant system.
3. 100% pipe area or venturi patterns.
4. No spring torsional stress.
5. No mechanical adjustments.
6. Two lubricants handle most services
7. Extremely close tolerance between sealing surfaces.
8. Triple head seal.
9. Plug floated on Teflon washer.
10. Leak-proof double-ball and Lubricant-sealed check valve.
11. Full-threaded screw assures clean lubricant.
12. Extruding lubricant shows when system is full.

Without obligation, send REFERENCE Book 39—Section 5 on HOMESTEAD Lubricated PLUG VALVES.

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. BOX 42 CORAOPOLIS, PA.

poration as an instrument engineer, and two years with the Armour Research Foundation in Chicago. He received his B.S. degree in Mechanical Engineering from Illinois Institute of Technology.

Link-Belt Building In Portland

Link-Belt Co., Chicago, Ill., has announced that work has started on the Company's modern district sales office and warehouse building in Portland, Oregon. The new structure is located on the southeast corner of Industrial Street and N. W. 31st Avenue and will be occupied this fall.

The new company-owned building will include office space, large warehouse facilities and a factory branch store. It has been designed so that it can be easily expanded in the future, if desired. Ample space has been provided for off-the-street parking. The Austin Company is designer and builder.

Chicago Bridge Advances Zimmerman

The Chicago Bridge & Iron Company, Chicago, Ill., has announced the appointment of E. N. Zimmerman as Advertising Manager.

Mr. Zimmerman started with the Chicago Bridge & Iron Company in 1937 and worked in their Greenville, Pa., Drafting room, Plant, and Purchasing department, before being transferred to Chicago in 1945 as Assistant Advertising Manager.

Lipke Advanced by Hagan Corp.

Hagan Corporation, Pittsburgh, Pa., has announced that Gerald G. Lipke has been appointed Manager of Sales, Standard Products.

Mr. Lipke was formerly Sales Manager of Hagan's Pittsburgh District Sales Office. He joined the Hagan organization in 1936 as a service engineer with Hall Laboratories, Inc., a Hagan subsidiary.

MacDonald Appointed By Combustion Engineering

Combustion Engineering, Inc., New York, N. Y., has announced that Warren L. MacDonald has been appointed District Manager of the Los Angeles office of the Company.

A graduate of the University of Oklahoma, where he was awarded an electrical engineering degree in 1946, Mr. MacDonald served as a project engineer for the Fluor Corp., Ltd., until June 1951, when he joined the sales department of Combustion Engineering, Inc., in the Los Angeles office.

Foxboro Opens Branch Factory in Pittsburgh

The Foxboro Company of Foxboro, Mass., has announced the opening of a new 15,000 square foot plant at 2270 Noblestown Road, Pittsburgh, Pa. The new factory, located a short distance from the new East and West Parkway and the Greater Pittsburgh Airport, will double the present instrument assembly, service and repair facilities, keeping pace with increased demands for instrumentation throughout industrial Pennsylvania, West Virginia, Kentucky and Ohio.

The new building is erected on two levels. General offices and sales headquarters occupy the lower level, with an upper level extension of 12,000 square feet where instruments and control valves will be assembled, serviced and stocked. Construction is steel and masonry with modern brick exterior. The building is situated on a two-acre site with ample space for parking and for a future third level expansion.

The
FORD
Yokebox
A Better Meter Setting for Shallow Services
A simple, compact meter housing, complete with service valve, for warm climate installations. The modern and better way to install water meters. Gives better protection, keeps meter cleaner. An investment in easier meter reading, longer meter life and greater revenue.
Write for information on the Yokebox.
1. Small lid, clean meter, speeds meter reading.
2. Easy to handle, quickly installed as a unit.
3. Meter changes quick and easy, without cumbersome tools.
4. Service valve easily operated and well protected.
FORD
FOR BETTER WATER SERVICES
THE FORD METER BOX COMPANY, INC. Wabash, Indiana

Literature & Catalogs

Tractor Mounted Power Digger

1015

Sherman Products, Inc., Royal Oak, Michigan, has just released an attractive 4-page, 2-color folder on the **Sherman Power Diggers.**

The folder discusses the new features and how these features add up to productive, low cost digging. Page 3 contains a large photograph of the digger with descriptive text pointing out all the special features. The last page shows six examples of the digger at work and a complete list of specifications.

Trebler Sampler

1016

Lakeside Engineering Corporation, Chicago, Ill., has available a bulletin on the **Trebler Sampler** for sampling sewage, trade wastes or other liquids.

Under the heading Description and Operation of Samplers the following subjects are discussed: Types of Samplers; Construction; Weirs and Parshall Flumes; Manhole Installations; Scoops; Time Clock Control; and Operation and Care. Installation diagrams, and charts giving dimensions of the various types of weirs and flumes are also included. Photographs and a short discussion of Spiraflo Clarifiers and Spiragesters complete the bulletin.

Automatic-Hydraulic Valves and Specialties

1017

Ross Valve Manufacturing Co., Inc., Troy, New York, has available a catalog on **Ross Automatic —Hydraulic Valves and Specialties.**

This attractive 100-page catalog is a virtual hand-book of the complete Ross line of equipment. Photographs are shown for each valve and in some cases actual installations are shown. The catalog is also profusely illustrated with mechanical drawings of the equipment and are accompanied by a keyed explanatory text. Helpful charts and piping diagrams are also included.

Industrial Water

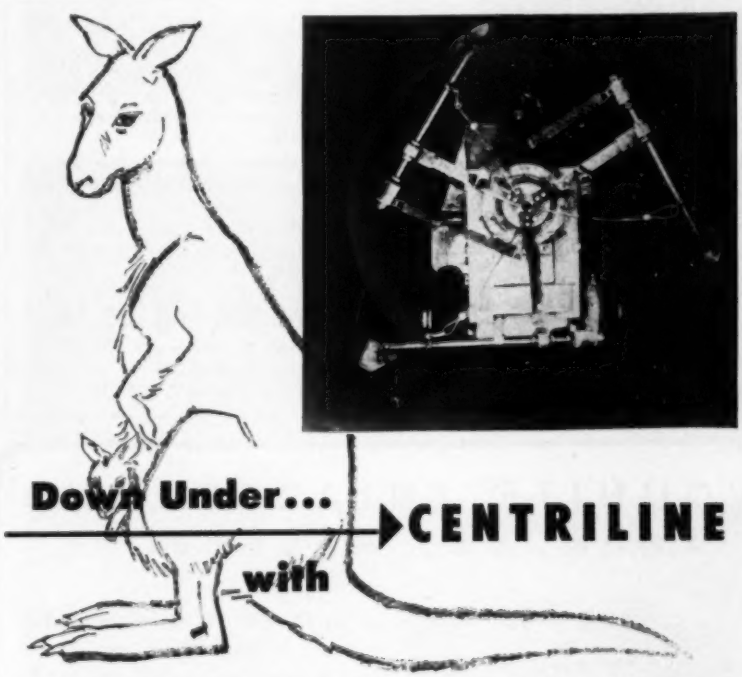
1018

Hall Laboratories, Inc., Pittsburgh, Pa., has just condensed the highlights of 30 years devotion to solving problems related to the procurement, treatment, use and disposal of industrial water into a new 10-page booklet, **"What Is Hall Laboratories?"**

Briefly touching on production problems in steel, textile, chemical and metal plating plants, plus a paper mill and a refinery, the new literature reports on Hall Laboratories tracing the cause of troubles to the industrial water system—between its source and its final effluent.

The booklet reviews the continued progress of Hall Laboratories in making industrial water behave. It scans the work of Hall field engineers in district offices and presents the facilities of its service laboratories.

Final pages in the booklet tell of the operations specialists in water management and the process industries specialists of Hall Laboratories who are available to originate water treatment procedures and to undertake investigations when trouble threatens.



In two of Australia's important cities, Centriline is currently playing a major role in the rejuvenation of water systems. The Metropolitan Water Sewerage and Drainage Board of Sydney, within the next five years, will Centriline approximately 60 miles of its water mains, 30" to 48" in diameter. In a suburb of Melbourne, the Hunter Water District has turned to Centriline for the cement-mortar lining of over 19,000 feet of 36" steel pipe.

Both of these Australian municipalities, like hundreds of others in the United States, have selected this process because they know that Centriline means absolutely no tuberculation or corrosion . . . lower pumping costs . . . higher carrying capacity . . . new pipe life . . . and no excavation and traffic tie-up. (The Centriline machine runs through the pipes while pipes remain in-place.) Add decades to the life of *your* water system—call on Centriline.

3,500,000 FEET OF EXPERIENCE

CEMENT-MORTAR LINING OF PIPES IN PLACE

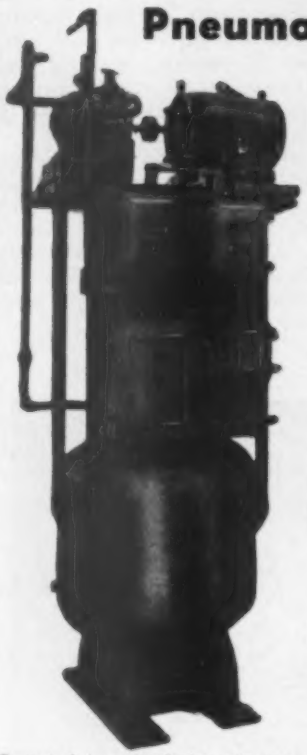
CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET • NEW YORK 6, N.Y.

Branch Offices in Principal Cities of United States and Latin America

Pneumatic Sewage Ejectors



BLACKBURN-SMITH GIVES
30 TO 500 G.P.M.
STRAIGHT UP - 150 FEET
ONCE A MINUTE
A REAL LIFT - WITHOUT FAIL

Be certain of satisfaction

No more complex piping for air and water. Eliminate clogging of screens, impellers, and shredders.

30 to 500 GPM in both single and twin units against high discharge heads.

Exclusive Modern Features

Over 50 years service has proved the worth of Blackburn-Smith Ejectors. Yet today's product has exclusive modern features such as:

1. Float and electrical float switch controls.
2. Float and pneumatically controlled snap action valve.
3. Electrode controls.

Any one of the above with or without Air Receivers. Get Catalog S50.

Compact ejector system having motor compressor assembly and all controls in one "packaged" unit.

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N.Y. Tel.: BArclay 7-0600

"GUNITE" ENLARGES AND IMPROVES RESERVOIR

Recently we "GUNITED" the West End Reservoir at Hagerstown, Maryland. The pictures clearly show important stages in our work to give it greater capacity and to stop excessive leakage. After existing cracks in the concrete floor were sealed, "GUNITE" was applied to waterproof and reinforce the stone masonry and to add 30 inches to the height of the walls.

Many instances of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin C2400. A request on your letterhead will bring your free copy by return mail.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES - ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE CEMENT GUN

Ball Valves

1019

S. Morgan Smith Company, York, Pennsylvania, has issued an eight-page brochure in color on its new line of manually-operated **Smith Ball Valves,** which are first being offered in sizes from 12 inches to 48 inches for shut-off service at pressures up to 150 p.s.i., for water works and industrial applications.

The brochure's introduction states that these are "Smith-designed and engineered versions of proved and accepted products, built under license." The manual Smith Ball Valves are designed for 150 p.s.i. working pressure with 125 p.s.i., A.S.A. flanges (C.I.), and have three principal parts—the body, rotor, and operating mechanism.

Principal technical section of the bulletin concerns "Valve Characteristics" with sub-sections on closing conditions, tightness of closure, leverage, the operating mechanism, and optional end sections. Other pages have front view assembly and sectional assembly drawings, with descriptions of standard settings, sectional assembly, and principal parts lists.

Water Conditioning Data Book

1020

The Permutit Company, New York, N. Y., has just released a new edition of the ever popular Permutit pocket-size **Water Conditioning Data Book.** This practical reference volume supersedes an earlier volume produced in 1952. Brought up-to-date and completely revised, it presents a compilation of 78 chapters and tables, all valuable to the engineer.

The subjects covered, to name a few, include: hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships, specific gravities, chemical reactions, hydraulic conversion factors, etc.

This handsome, gold-imprinted, leatherette volume, in the very handy 5 by 7¼ inch size, contains 108 information-packed pages. It is available to practicing engineers and to those who work with water conditioning problems.

Weed Killer

1021

The Grasselli Chemicals Department of the Du Pont Company, Wilmington, Delaware, has available a booklet on Du Pont **"Telvar" W Weed Killer.**

This attractive 10-page booklet is profusely illustrated with "before" and "after" photographs in full color accompanied by short descriptive text. Application instructions and a list of district sales offices complete the booklet.

Concrete Pipe

1022

Universal Concrete Pipe Co., Columbus, Ohio, has available a 16-page booklet on **Universal Concrete Pipe.**

The booklet gives complete specification charts on Non-Reinforced Sewer Pipe; Machine Bell end Reinforced; Machine Tongue & Groove Reinforced; Bell End Extra Strength Reinforced; Cast Tongue and Groove Reinforced; Machine Made Clay Lined Reinforced; and Clay Liner Plate Reinforced. This is followed by charts giving: Flow of water in concrete pipe; capacity comparison of concrete and corrugated metal pipe culverts; capacities of concrete pipe culverts; theoretical loads on pipe in trenches; determining area and weight of reinforcing; thickness and weights of sheets and plates.

Radius pipe tables and the layout for jacking 48 inch concrete pipe complete the booklet.

Sludge Vacuum Filter

1023

Komline-Sanderson Engineering Corporation, Peapack, N. J., has released a 4-page bulletin on the **Komline-Sanderson Coilfilter.**

The bulletin describes the Coilfilter as the only completely modern sludge vacuum filter. Some of the features described are: Non-Clogging; Permanent Filter Media; Constant output; and low operating cost. Actual installation photographs, a schematic drawing of the Coilfilter and a chart of the standard sizes are also included.

Lubricated Plug Valves

1024

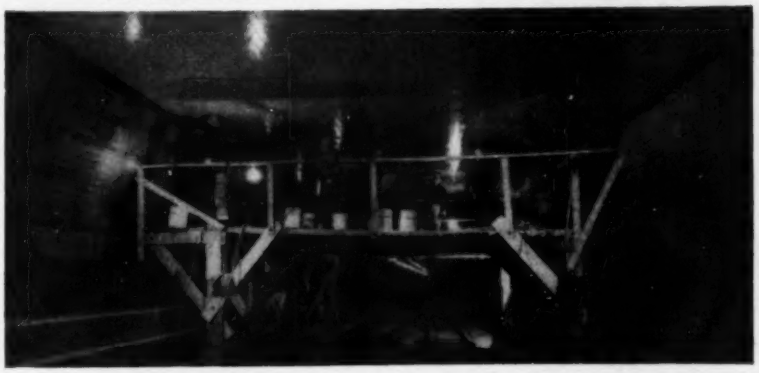
Homestead Valve Manufacturing Company, Corapolis, Pa., has just released a new 24-page reference book on **Homestead Self-Seald Lubricated Plug Valves.**

Underneath the river!

THORITE Patching Mortar Crew at work in Air Tunnel under East River, New York.

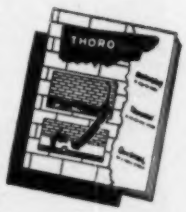
Sealing Leaks in Traffic Tunnel with WATERPLUG.

Sealing Drain Pipe Channels in Tunnel with WATERPLUG.



WATERPLUG Crew at work, before placing of tile lining, Battery Tunnels, East River, New York.

On many of the largest underground projects in the Americas and in foreign countries, WATERPLUG solves, for the contractor, his water problems. The job may be small or it may be large, the results are the same — Successful.



Get our 20-page brochure, pictorially describing, in detail, "How To Do It." It's yours for the asking. — No. 140.

Standard Dry Wall Products

BOX X, NEW EAGLE, PENNSYLVANIA

The reference book shows the valves in full-port and venturi types, sizes up to 14 inches, and with a choice of self-seald two-piece plug or one-piece plug designs. Engineering information includes principal dimensions, types of control, metals, lubricants, etc.

Trenchmobile

1025

Parsons Company, Newton, Ia,, has just released a new two-color, eight page catalog describing dozens of applications for the improved **Parsons 88 Trenchmobile.** According to the catalog the Model 88 will dig up to five feet deep in widths of eight, 12, or 16 inches. Maximum rate of advance is 14½ feet per minute.

The new catalog is illustrated with many photos showing the Trenchmobile, its operating parts, and performance on the job. It will prove a handy guide to the contractor who wants a rubber-tired trenching machine which will travel on roads under its own power and step up work schedules on scattered, small yardage jobs.

LOOK FOR THIS MARK
OF QUALITY
ON VALVES AND HYDRANTS
The widespread and fast-growing demand for M & H Valves, Hydrants and accessories is due primarily to outstanding superior quality in design, materials and workmanship. In the M & H double-disc gate valve, for example, the iron body and the bonnet flanges are heavily proportioned and unusually strong. The discs are held in alignment by guides and are seated or released by three point action of bronze spreaders. The bronze seat rings are exceptionally heavy. Either disc may be used on the down-stream side. For additional information about the advantages of M & H Valves or Hydrants, write M & H VALVE and FITTINGS COMPANY, ANNISTON, ALABAMA.
M&H PRODUCTS
FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Wrought Iron Pipe

1026

A. M. Byers Company, Pittsgurgh, Pa., has just published a 32-page bulletin entitled **"Piping for Permanence."** The bulletin is designed for engineers and others who specify for piping services.

Contained in the illustrated bulletin is helpful technical data based on an analysis of thousands of piping systems in which wrought iron is specified to help solve corrosion problems. Sections of the new publication are devoted to a round-up of wrought iron pipe installations, a review of piping properties essential to long and economical service life, descriptions of individual service in building-piping systems and recommendations to help reduce the rate and severity of corrosion.

Authenticated service records that point up the ability of wrought iron to resist corrosion are listed near the end of the booklet. The service records embrace buildings in all sections of the country and date as far back as the year 1850.

Also included in the bulletin is an eleven page chapter that deals exclusively with water analysis and treatment.

Concrete Pressure Pipe

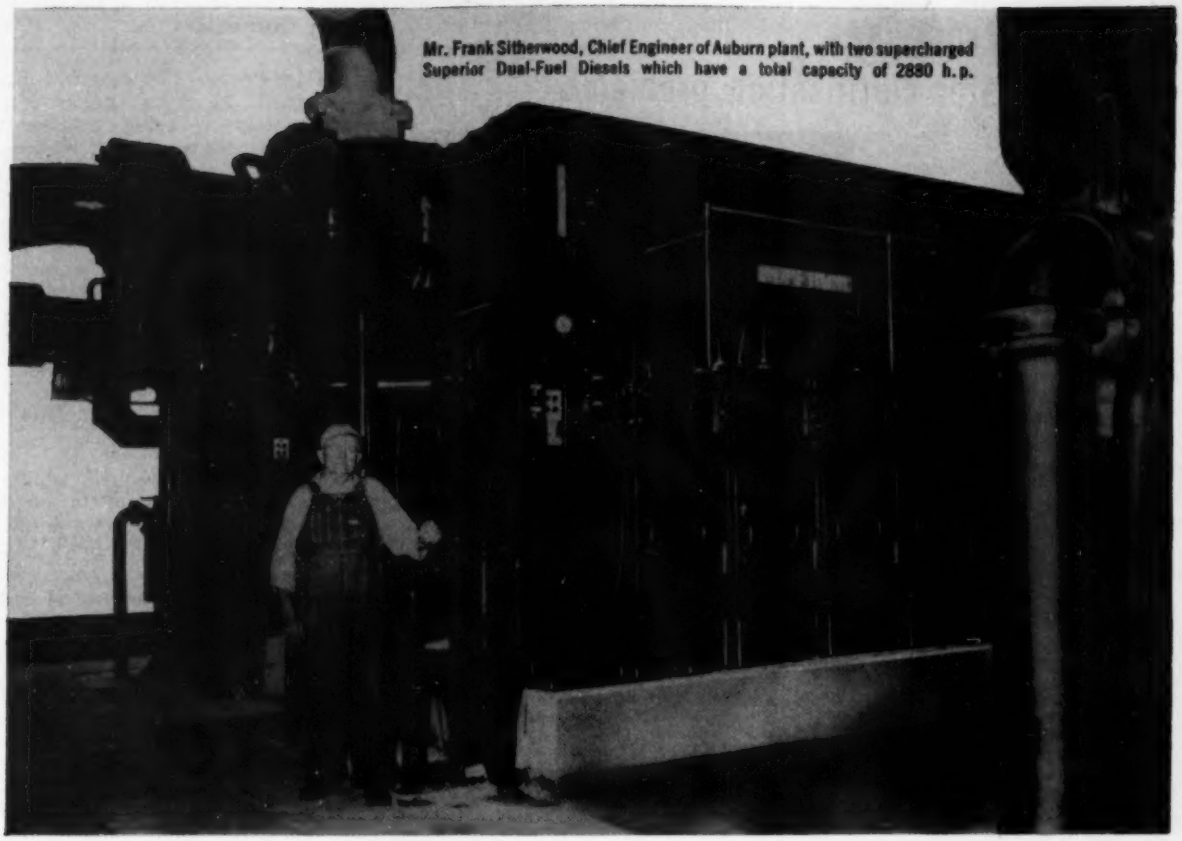
1027

Price Brothers Co., Dayton, Ohio, has just published a new, attractive, fully illustrated, color booklet entitled **"The Story of Concrete Pressure Pipe."**

Simply, clearly, concisely written, valuable for engineer, contractor and layman, the 24-page booklet deals with the history of concrete in water lines, and its present application in prestressed concrete pressure pipe.

There are fourteen sections. One of them, "How Prestressing Works," shows with simple drawings the principals of tension and compression in the pipe, and how prestressing makes possible near "zero" compression with the water line operating at design pressure.

A catalog section lists and illustrates types of Price concrete pressure pipe for water transmission and distribution lines, subaqueous intakes and outfalls, and sewage force mains. Included are cutaway drawings of each type of pipe, with sizes, weights and normal operating heads.



Mr. Frank Sitherwood, Chief Engineer of Auburn plant, with two supercharged Superior Dual-Fuel Diesels which have a total capacity of 2880 h.p.

Auburn, Nebraska, pays off power plant debt

5 years ahead of schedule!

This year, the Board of Public Works of Auburn, Nebraska, plans to pay the last $76,000 of a bonded debt which totaled $279,000.00, five years ago. This final payment is five years ahead of schedule, for which the Board gives credit to a pair of Superior Dual-Fuel Diesels.

The first Superior, originally a straight diesel rated at 960 h.p., was installed in the power plant in 1946. Dual-fuel equipment was added in 1948, to enable the engine to operate on diesel or natural gas, depending on supply and price.

The following year, the Board produced 190,000 *more* kilowatt hours of electricity for 21,800 *less* dollars. Fuel savings accounted for all but $250 of the total cost reduction!

When Auburn's generating capacity had to be increased in 1949, the Board bought a new Superior supercharged dual-fuel diesel—for obvious reasons—and in 1952, added a supercharger to the first one.

This is just one example of the many outstanding economy records made by Superior and Atlas Diesels. You can easily get more information on the engines to profitably meet your power needs by calling the nearest sales and service office listed below.

DIESEL DUAL FUEL GAS ATLAS Imperial DIESEL ENGINES Superior ENGINES DISTRIBUTOR OF Lister DIESELS IN U.S.A.

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• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

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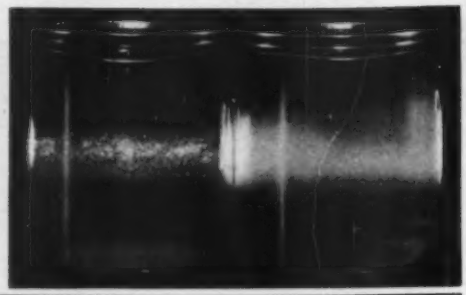
Floc formed by N-Sol Activated Silica Sol and your regular coagulant is large, bulky and strong, settling rapidly to produce clear, sparkling water. Choose the N-Sol Process coagulant aid to fit your operation. No charge for license under N-Sol patents.



PROCESS	REACTANT	ADVANTAGE
N-Sol-A (U.S. Pat. 2,444,774)	Ammonium sulphate	Ease of preparation, either batch or continuous. Facilitates the production of chloromines for sterilization.
N-Sol-B (U.S. Pat. 2,310,009)	Alum	Reactant readily available, inexpensive.
N-Sol-C (U.S. Pat. 2,567,285)	Chlorine	Reactant usually available where sterilization is normal practice.
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Activated silica sol is made in your plant from our N® Sodium Silicate shipped in drums or tank cars.

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PQ

N-Sol® Processes
PQ® SOLUBLE SILICATES

REPAIR BROKEN MAINS

SKINNER-SEAL Split Coupling Clamp for dependable and lasting repair of broken mains. Sizes 2" to 24" inclusive. Write for catalog.

M. B. SKINNER COMPANY
SOUTH BEND, INDIANA

Surer Gland Lubrication for Centrifugal Pumps
THE Z-F GREASE SEAL

Eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price.

ZIMMER and FRANCESCON
MOLINE, ILLINOIS

Rotary Distributors
1028

Walker Process Equipment, Inc., Aurora, Ill., have just released a new bulletin covering Rotoseal **Rotary Distributors** for trickling filters.

Complete details of the Walker Rotoseal Rotary Distributors in sizes ranging to 216′ maximum bed diameter are included. In addition the bulletin contains discussions and design data to assist in designing the complete trickling filter unit.

Safety Booklet
1029

National Safety Council, Chicago, Ill., has an answer for the skeptical worker who wants to know what he stands to gain from working safely, in its new employee training booklet, **"What's in It For Me."**

The 16-page booklet shows that everyone—the employer, the public and the worker—gains from a good safety program. Stressing the theme that no one is immune to accidents if he is not careful, the booklet drives home the fact that it is not where you work but how you work that makes for safety.

"What's in It For Me?" encourages the worker to help himself to happier, accident-free living by aiding the company in its fight against accidents. By reporting unsafe conditions and unsafe acts, the worker can help find a better and safer way of doing the job.

Illustrated in four colors, the booklet uses few words, but plenty of cartoons, to put across its message.

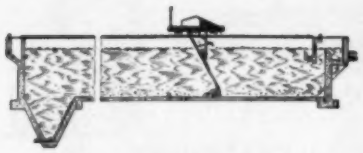
Composite Instrument Catalog
1030

Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., has announced the availability of their revised **Composite Catalog** containing many new features.

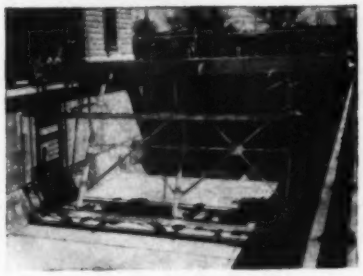
The catalog contains a photograph and brief description of all Brown Instruments and gives comprehensive coverage of the products of Honeywell's Industrial Division.

Plug Value Actuators
1035

Ledeen Manufacturing Co., Los Angeles, Calif., has just released an 8-page bulletin on **Plug Valve Actuators.**



Rectangular Clarifiers



Particularly suitable where space is limited or where sludge delivery is desired at one end of tank. Consists of a bridge crane spanning width of the tank supporting sludge scraper and skimmer, which move automatically back and forth.

Many of these units are now operating in sewage plants throughout the country.

This unit has also proven highly successful as an oil-water separator in the treatment of oil refinery waste water. Bulletin 31-D-15

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COMPANY INCORPORATED
YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works
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TEST FOR SYNTHETIC DETERGENTS— *quickly*— *with* TAYLOR SYNDET COMPARATOR

Improper sedimentation or excess foaming of sewage may be due to excessive synthetic detergent content. These difficulties can be anticipated by knowing synthetic detergent content of sewage. Now you can make accurate syndet determinations with the specially designed Taylor Syndet Comparator.

ACCURACY ASSURED

All Taylor Comparators use the colorimetric method of comparison . . . and all Taylor Liquid Color Standards are unconditionally guaranteed against fading! Thus, there's no danger of mechanical inaccuracy in making tests. Syndet Comparator reads from 0 to 10 ppm and all color standards are mounted in a single plastic slide. Complete set includes slide, base and all accessories and reagents.

SEE YOUR DEALER for the Taylor Syndet Comparator; also ask about sets for pH, chlorine, phosphate, other determinations. Write direct for free book "Modern pH and Chlorine Control."

W. A. TAYLOR AND CO.
7308 YORK RD. • BALTIMORE 4, MD

This bulletin describes tandem type actuators for valves requiring relatively high torques to operate, and the new floating bar type actuators for use on valves requiring lower operating torques. The bulletin also shows actuator selection table, typical applications, dimensions and weights, and various mountings.

Fiberglas Reinforcement For Underground Pipe
1031

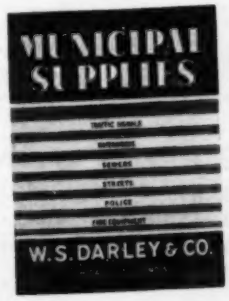
Owens-Corning Fiberglas Corporation, Toledo, Ohio, has just published a new four-page booklet listing the advantages of **Fiberglas Coromat** as reinforcement for enamel on underground pipe.

The booklet also lists the Fiberglas Coromat distributors in the various parts of the nation and has an estimating table for determining the quantity of Coromat required per mile for various size pipe.

Modern pH and Chlorine Control
1032

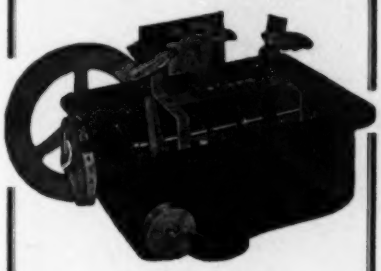
W. A. Taylor & Company, Baltimore, Maryland, has issued the eleventh edition of their well known handbook, **Modern pH and Chlorine Control.**

This 100 page book illustrates and describes the complete Taylor line of colorimetric comparators for pH, chlorine, phosphate, etc., and for water analysis. New items not previously described are a Quaternary Ammonium Compound Titration Set, a Syndet Comparator for determining synthetic detergents in water and sewage, a High Nitrite Comparator for use on cooling waters where sodium nitrite is being used as a corrosion inhibitor, and a special lamp designed for use with the well known Taylor Water Analyzer.



Write Today For 100 Page Catalog
W. S. DARLEY & CO., Chicago 12

ROTO-TROL



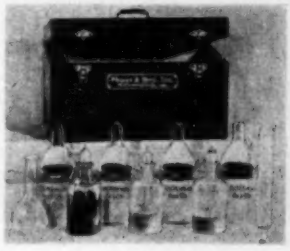
RF-2

WITH ALTO-TROL This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 HAMPDEN AVE., ST. PAUL 4, MINN.

BALDWIN ALUMINA SET



For quickly determining the residual alum in filtered water. The complete apparatus includes reagents, color standards and portable hardwood carrying case. The case protects the apparatus from possible contamination with alum dust. Complete with directions for use.

82-760 ..... Each $65.00

Write

Phipps & Bird, Inc.
6th & Byrd St., Richmond, Virginia
(2385 Rhode Island Ave., N.E. Washington, D. C.)

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

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ANTHRAFILT
Trade Mark Reg. U. S. Patent Office
A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Building
Wilkes-Barre, Pa.

All correspondence regarding sales and engineering should be addressed to:

PALMER FILTER EQUIPMENT CO.
822 E. 8th St. Erie, Pa.
—Engineers and Sales Agents

In addition to descriptions of the various comparators developed by the Taylor Company, this book contains information gathered during the many years that the company has been in business. This includes simple and technical discussions of the meaning of pH control, the application of pH, chlorine and phosphate control to many different industries, as well as precautions which must be observed in making the various tests.

Spiral Rake Thickener

1033

Denver Equipment Co., Denver, Colo., has just published a 12-page bulletin on the **Denver Spiral Rake Thickener.**

Years of field service and experience have been incorporated in design of the Denver Spiral Rake Thickeners and are documented by data, drawings and photographs in this bulletin. Dimensions, specifications and capacities of steel, wood or concrete thickener tanks in sizes ranging from 3 to 80 feet are given. Photographs show thickeners in operation throughout the world. Features such as the overload indicator and the automatic rake lifting device are explained. A suggested circuit completely equipped for thickening and filtering is shown in flowsheet study form.

Chlorinator Automatic Proportioner

1034

Fischer & Porter Company, Hatboro, Pennsylvania, has just published a catalog on the **Automatic Proportioning Unit** for use with the Fischer & Porter Chlorinator.

The catalog describes the unit and is illustrated with a flow diagram, cross-section drawing, installation drawing, and specifications.

WANTED

WANTED
ASSISTANT PLANTS SUPERINTENDENT

Assistant Plants Superintendent to take responsible charge of Sewage Treatment Plants. Must be available August 1, 1954. Send complete resume of qualifications and salary expected to C. E. Steeler, Director of Personnel and Public Relations, Water and Sewer Department, Room 402, City Hall, Tulsa, Oklahoma.

REPRESENTATION WANTED

Metropolitan New York Area. Well established manufacturers' agency desires to broaden their activities and are interested in additional representation. Write Box 1123, *Water & Sewage Works*, 185 N. Wabash Avenue, Chicago 1, Illinois.

POSITION

Position open for Director of Public Works for City of Wisconsin Dells. Apply in writing to City Clerk, Wisconsin Dells, Wis.

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DEPENDABLE JOINTING COMPOUND
Seals Bell and Spigot Water Mains
Economical—Effective
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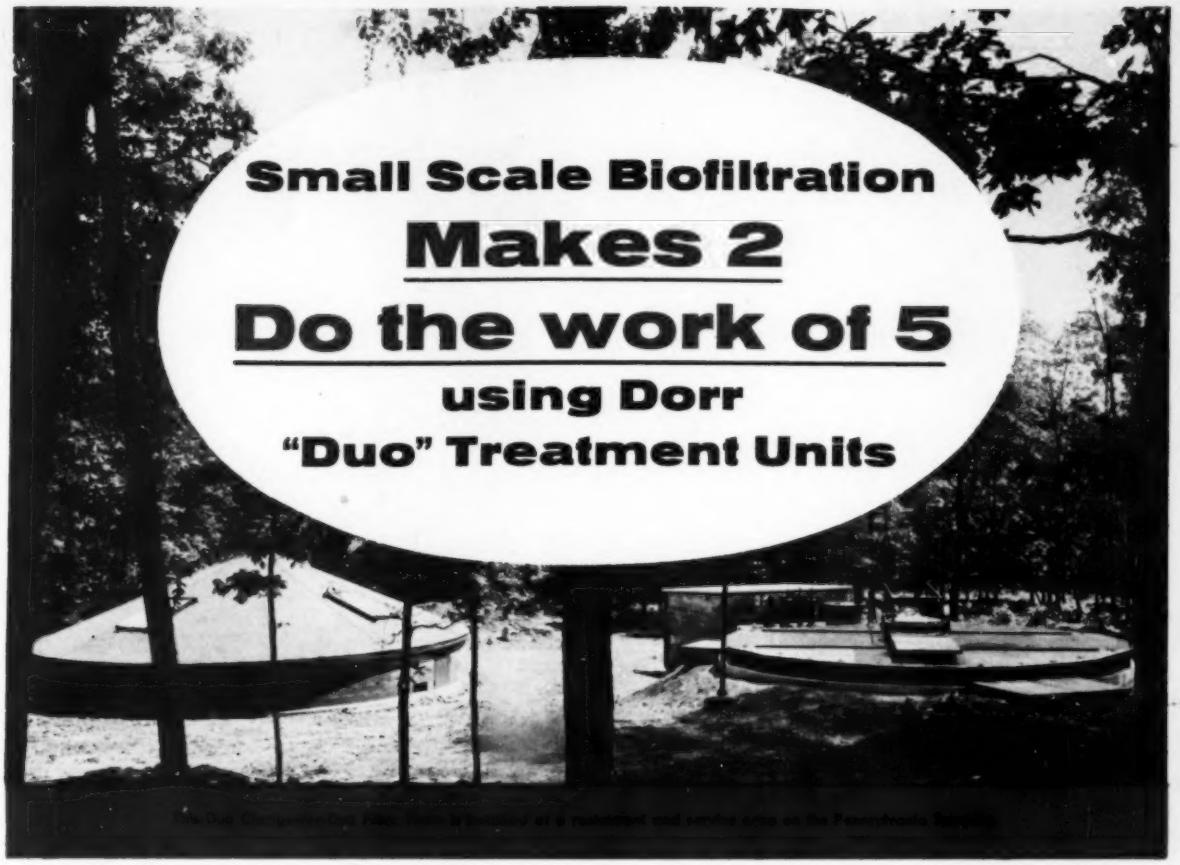

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